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Biological Monitoring of Toxic Trace Metals
Volume 2. Toxic Trace Metals in Plants and Animals of the World. Part III

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Sarasota, FL

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BIOLOGICAL MONITORING OF TOXIC TRACE METALS
Volume 2. Toxic Trace Metals in Plants and Animals of the World
Part III

by

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16. ABSTRACT

The needs and priorities in using biological accumulator organisms for monitoring toxic trace metals in plants and animals are analyzed. The toxic trace metals selected for study are antimony, arsenic, beryllium, boron, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, tin, and vanadium. Data on the toxicity to humans, abundance, production, use and emissions of trace elements are presented and sources and pathways to plants and animals listed.

Volume 1 of the two volumes evaluates available data for the purpose of selecting biological monitoring organisms to monitor the 14 selected toxic metals, and recommends various organisms for use in national and international monitoring systems and networks. This study is based on the data compilation in Volume 2.

Volume 2 brings together the majority of the significant data on bioaccumulation and bioconcentration of the 14 trace metals discussed, which are considered to be of most importance to man and his food organisms. This volume provides a concise reference of baseline data for delineating the background or "normal" levels of toxic trace metals as well as levels that occur under various pollutant conditions.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
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NICKEL IN MAMMALS(1)

Species	Locality	Tissue	Analysis(2) PPM	Authority
Cow *Bos bovis*	France	liver	W 0.125	Bertrand & Macheboeuf (1925)
" "	"	"	D 0.36	"
" "	"	pancreas	W 0.135	"
" "	"	"	D 0.41	"
" "	"	testicle	W 0.032	"
" "	"	"	D 0.22	"
" "	"	brain	W 0.033	"
" "	"	"	D 0.15	"
" "	"	blood	W 0.011	"
" "	"	"	D 0.057	"
" "	"	kidney	W 0.01	"
" "	"	"	D 0.047	"
" "	"	calf liver	W 0.125	"
" "	"	" "	D 0.5	"

(1) Blank spaces indicate information not available or not applicable. ? indicates questionable data.

(2) W, D or A indicates on a Wet, Dry or Ashed basis. A single number indicates a single determination or mean. (x-y) indicates range of values, followed by the mean. ± Standard deviation (SD), standard error (SE), median, and geometric mean are indicated as reported. pCi/g = picocuries per gram.

Cow Bos bovis	France	milk	W	0.004	Bertrand & Macheboeuf (1925)
" "	"	"	D	0.04	"
" "	New England	bone marrow	W	0.22	Schroeder et al. (1962)
" "	" "	bone	W	0.58	"
" "	" "	muscle	W	0.0	"
" "	" "	kidney	W	0.66	"
" "	" "	feces	W	0.75	"
" "	United States	calf pancreas RNA	W	130.0	Wacker & Vallee (1959)
" "	" "	calf thymus RNA	W	74.0	"
Guinea pig Cavia porcellus		hair	trace		Kikkawa et al. (1958)
Horse Equus caballus	United States	kidney RNA	W	44.0	Wacker & Vallee (1959)
Mouse Mus musculus	United States	ave.	W	(0.32-0.46)	Schroeder et al. (1964)
" "	" "	kidney	W	(0.46-0.52)	"
" "	" "	liver	W	(0.20-0.62)	"
" "	" "	heart	W	(0.0-0.43)	"
" "	" "	lung	W	(0.32-0.61)	"
" "	" "	spleen	W	(0.33-0.42)	"
" "	France	whole	W	0.025	Bertrand & Macheboeuf (1925)
" "	"	"	D	0.084	"

White-tailed deer *Odocoilus virginianus*	New England	kidney	W	(0.0-2.9)	Schroeder et al. (1962)
" "	" "	kidney (spectrographic)	W	(0.0-0.66)	"
" "	" "	liver	W	(0.0-2.5)	"
Rabbit *Oryctolagus cuniculus*		hair (black)		0.18±0.08	Kikkawa et al. (1958)
" "		hair (white)		1.7±0.41	"
" "	United States	reticulocyte RNA	W	51.0	Wacker & Vallee (1959)
Sheep *Ovis aries*	New England	muscle	W	0.0	Schroeder et al. (1962)
Harbor seal *Phoca vitulina*	Scotland	blood	W	3.4±2.0	Hamilton (1976)
" "	"	spleen	W	<10.0	"
" "	"	heart	W	<8.0	"
" "	"	muscle	W	<10.0	"
" "	"	kidney	W	<10.0	"
" "	"	liver	W	9.0±6.0	"
Rat *Rattus rattus*	United States	liver RNA	W	64.0	Wacker & Vallee (1959)
Gray squirrel *Sciurus carolinensis*	New England	kidney	W	3.19	Schroeder et al. (1962)
" "	" "	liver	W	1.51	"
" "	" "	heart	W	3.67	"

Red squirrel *Sciurus hudsonicus*	New England	kidney	W	0.0	Schroeder et al. (1962)
" "	" "	liver	W	0.0	"
Pig *Sus scrofa*	" "	muscle	W	(0.0-0.02)	"
" "	" "	kidney	W	(0.0-3.4)	"
Cottontail rabbit *Sylvilagus floridanus*	" "	"	W	(0.0-0.08)	"
" "	" "	liver	W	2.33	"

NICKEL IN BIRDS(1)

Species	Locality	Tissue	Analysis(2) PPM	Authority
Mallard *Anas platyrhynchos*	Canada	feather	D <0.05	Kelsall (1970)
Black duck *Anas rubripes*	"	"	D <0.05	"
White-fronted goose *Anser albifrons*	"	"	D <0.05	"
Lesser scaup *Aythya affinis*	"	"	D <0.05	"
Ruffed grouse *Bonasa umbellus*	New England	kidney	W 4.96	Schroeder et al. (1962)
" "	" "	liver	W (1.11-2.42)	"
Chicken *Gallus gallus*	France	egg white	W <0.002	Bertrand & Macheboeuf (1925)
" "	"	egg yolk	W 0.02	"
" "	"	" "	D 0.04	"
" "	New England	egg, whole	W 0.03	Schroeder et al. (1962)

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Bald eagle Haliaeetus leucocephalus	Wisconsin, Maine, Florida	egg (1968)	D	0.0	Krantz et al. (1970)
Lesser black-backed gull Larus fuscus fuscus	Norway	muscle	D	1.0	Lande (1977)
" " "	"	liver	D	2.0	"
" " "	"	kidney	D	5.0	"
Turkey Meleagris gallopavo	France	liver	W	0.015	Bertrand & Macheboeuf (1925)
" "	"	"	D	0.053	"
" "	"	muscle	W	<0.002	"
" "	"	feather	W	0.3	"
" "	"	"	D	0.33	"
Brown pelican Pelecanus occidentalis	South Carolina	egg	W	(0.01-0.072) 0.022	Blus et al. (1977)
" "	"	liver	W	(0.039-0.078)	"
" "	Florida	egg	W	(0.009-0.042) 0.023	"
" "	"	liver	W	0.019-0.058)	"
" "	Georgia	liver	W	0.016	"
Eider Somateria mollissima	Norway	muscle	D	2.0	Lande (1977)
" "	"	liver	D	1.0	"
" "	"	kidney	D	2.0	"
" "	"	egg	D	1.0	"
Robin Turdus migratorius	New England	kidney	W	1.66	Schroeder et al. (1962)
" "	" "	liver	W	0.91	"

NICKEL IN MARINE FISH(1)

Species	Locality	Tissue	Analysis(2) PPM	Authority
Atlantic wolf fish, catfish *Anarchichas lupus*	Norway		D 4.0	Lande (1977)
Deepbody anchovy *Anchoa compressa*	Los Angeles harbor	muscle	D 13.6	Emerson et al. (1976)
Blue hake *Antimora rostrata*	Middle Atlantic	muscle	W <0.51	Greig et al. (1976)
" "	"	liver	W (<0.45-<0.48)	"
Atlantic argentine *Argentina silus*	Norway		D 3.0	Lande (1977)
Jolthead, porgy *Calamus bajonado*	Puerto Rico		W 14.0	Lowman et al. (1967)
" "	" "		D 23.0	"
" "	" "	intestine	W 1.7	"
" "	" "	"	D 7.5	"
" "	" "	gills	W 3.5	"
" "	" "	"	D 10.0	"

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Jolthead, porgy Calamus bajonado	Puerto Rico	muscle	W	0.33	Lowman et al. (1967)
" "	" "	"	D	1.4	"
" "	" "	eye	W	1.4	"
" "	" "	"	D	7.1	"
" "	" "	scale	W	12.0	"
" "	" "	"	D	16.0	"
Whitetip oceanic shark Carcharinus longimanus	Puerto Rico	liver	W	0.054	"
" "	" "	"	D	0.097	"
" "	" "	vertebra	W	1.6	"
" "	" "	"	D	4.9	"
" "	" "	skin	W	1.9	"
" "	" "	"	D	7.3	"
Rabbit fish Chimaera monstrosa	Norway		D	5.0	Lande (1977)
Atlantic herring Clupea harengus	"		D	4.0	"
Grenadier Coryphaenoides rupestris (= Macrurus rupestris)	"		D	4.0	"
Ctengraulis edentulus	Puerto Rico		W	(1.0-3.6) 2.26	Lowman et al. (1965)
" "	" "		D	(4.5-16.0) 6.4	"
Wrass Ctenolabrus rupestris	Sweden		D	30.0	Noddack & Noddack (1940)
Lumpsucker Cyclopterus lumpus	Great Britain	skin	W	3.90	Wright (1976)

Lumpsucker *Cyclopterus lumpus*	Great Britain	stomach	W	3.75	Wright (1976)
" "	" "	liver	W	3.96	"
" "	" "	fat body	W	3.19	"
" "	" "	kidney	W	5.52	"
" "	" "	muscle	W	3.40	"
Sand seatrout *Cynoscion arenarius*	Texas	muscle	D	(2.8-5.1)4.0	Horowitz & Presley (1977)
" "	"	skin	D	(1.3-2.4)1.9	"
" "	"	air bladder	D	0.8	"
" "	"	digestive tract	D	2.7	"
" "	"	liver	D	0.8	"
Shiner perch *Cymatogaster aggregata*	Los Angeles harbor	muscle	D	163.9	Emerson et al. (1976)
Diplodus vulgaris	Israel	muscle	D	1.7	Roth & Hornung (1977)
Ectnopus crossotus	Puerto Rico		W	0.88	Lowman et al. (1965)
" "	" "		D	3.7	"
Anchovy *Engraulis encrasicolus*	Adriatic Sea	skin	W	(1.3-4.5)2.5	Gilmartin & Revelante (1975)
" "	" "	gill	W	(0.5-1.0)0.7	"
" "	" "	muscle	W	(ND-0.5)0.2	"
" "	" "	gut	W	(ND-0.6)0.4	"
" "	" "	liver	W	ND	"

Anchovy Engraulis encrasicolus	Adriatic Sea	whole	W	(0.53-0.59) 0.56	Gilmartin & Revelante (1975)
" "	California	skin	W	0.4	Knauer (1972)
" "	"	gill	W	0.7	"
" "	"	muscle	W	ND	"
" "	"	viscera	W	1.1	"
" "	"	liver	W	ND	"
" "	"	gonad	W	ND	"
Northern anchovy Engraulis mordax	Los Angeles harbor	muscle	D	14.1	Emerson et al. (1976)
Anchovy Engraulis sp.		canned	W	0.72	Schroeder et al. (1962)
Grouper Epinephelus aeneus	Israel	muscle	D	(1.1-1.6)	Roth & Hornung (1977)
Grouper Epinephelus guaza	Israel	muscle	D	0.8	"
Priest shark Etmopterus spinax	Norway		D	6.0	Lande (1977)
Skipjack tuna Euthynnus pelamis	Pacific	whole	A	12.0	Goldberg (1962)
" "	Peru	muscle	W	2.0	Lowman et al. (1967)
" "	"	"	D	5.0	"
" "	Puerto Rico		W	(0.31-0.95) 0.5	Lowman et al. (1966)
" "	" "		D	(1.1-4.2)2.2	"

Atlantic cod _Gadus morhua_	Gulf of Kola	adult	A	1.0	Malyuga (1946)
" "	" " "	"	D	0.13	"
" "	" " "	"	W	0.24	"
" "	" " "	young	A	6.0	"
" "	" " "	"	D	1.0	"
" "	" " "	"	W	0.018	"
" "	Norway		D	(4.0-5.0)	Lande (1977)
" "	Great Britain	gill	W	3.3±SD 1.7	Wright (1976)
" "	" "	skin	W	3.2±SD 2.6	"
" "	" "	stomach wall	W	2.0±SD 1.1	"
" "	" "	liver	W	2.5±SD 1.6	"
" "	" "	fat body	W	1.6±SD 1.3	"
" "	" "	kidney	W	4.6±SD 5.3	"
" "	" "	muscle	W	2.3±SD 1.1	"
" "	" "	gonad	W	4.2±SD 2.9	"
Blackmouthed dogfish _Galeus melastomus_	Norway		D	4.0	Lande (1977)
White croaker _Genyonemus lineatus_	Los Angeles harbor	muscle	D	14.5	Emerson et al. (1976)
Witch flounder _Glyptocephalus cynoglossus_	Norway		D	4.0	Lande (1977)
Halosauropsis macrochir	Middle Atlantic	muscle	W	(<0.48- 0.5)	Greig et al. (1976)

Scaled sardine *Harengula sp.*	Puerto Rico		W	(1.1-7.2)2.8	Lowman et al. (1965)
" "	" "		D	(4.1-25.0)9.9	"
Soldier fish, squirrel fish *Holocentrus rufus*	" "		W	(2.5-4.2)3.1	"
" "	" "		D	(7.2-8.4)7.8	"
Lanternfish *Hygophum hygomi*	Middle Atlantic	whole	W	(0.37-0.74)	Greig et al. (1976)
Yellowtail flounder *Limanda ferruginea*	New York Bight	muscle	W	(<0.2-0.4)	Greig & Wenzloff (1977)
" "	New York Bight	liver	W	(0.2-1.1)	"
Dab *Limanda limanda* (= Pleuronectes limanda)	Great Britain	skin	W	3.0	Wright (1976)
" "	" "	stomach wall	W	1.2	"
" "	" "	liver	W	2.38	"
" "	" "	kidney	W	2.0	"
" "	" "	muscle	W	7.1	"
Blue marlin *Makaira nigricans*	Puerto Rico		W	(0.24-2.1) 0.83	Lowman et al. (1965)
" "	" "		D	(0.56-5.2)2.9	"
Haddock *Melanogrammus aeglefinus* (= Gadus aeglefinus)	Gulf of Kola		A	6.3	Malyuga (1946)
" "	" " "		D	1.0	"
" "	" " "		W	0.015	"
" "	United States	muscle	W	0.05	Schroeder et al (1962)

Haddock *Melanogrammus aeglefinus* (= Gadus aeglefinus)	Norway		D	(3.0-6.0)	Lande (1977)
" "	Great Britain	gill	W	3.4	Wright (1976)
" "	" "	skin	W	1.6	"
" "	" "	stomach wall	W	1.0	"
" "	" "	liver	W	1.7	"
" "	" "	fat body	W	0.5	"
" "	" "	kidney	W	3.6	"
" "	" "	muscle	W	0.5	"
Whiting *Merlangius merlangus* (= Gadus merlangus)	Norway		D	5.0	Lande (1977)
" "	France	whole	W	0.014	Bertrand & Macheboeuf (1925)
" "	"	"	D	0.068	"
" "	"	"	A	0.5	"
European hake *Merluccius merluccius*	Israel	muscle	D	(ND-1.0)0.4	Roth & Hornung (1977)
Atlantic croaker *Micropogon undulatus*	Texas	muscle	D	2.7	Horowitz & Presley (1977)
" "	"	skin	D	3.8	"
Dover sole *Microstomus pacificus*	California	muscle	W	(0.1-0.3)0.2	Fowler et al. (1975)
" "	"	"	D	<2.0	McDermott et al. (1976)
" "	"	gonad	D	(<2.0-<4.8)	"

Dover sole *Microstomus pacificus*	California	liver	D	(1.4-2.6)	McDermott et al. (1976)
Planehead filefish *Monacanthus hispidus* (=Stephanolepsis hispidus)	Middle Atlantic	whole	W	(0.48-<0.49)	Greig et al. (1976)
Striped bass *Morone saxatilis*	Long Island		W	1.45	Zawacki & Briggs (1976)
" "	" "		D	4.63	"
Goatfish *Mullus barbatus*	Israel	muscle	D	(1.4-1.8)1.6	Roth & Hornung (1977)
Smooth dogfish *Mustelus canis*	New York Bight	muscle	W	<0.3	Greig & Wenzloff (1977)
" "	New York Bight	liver	W	<0.3	"
Nematonurus armatus	Middle Atlantic	muscle	W	(<0.44-<0.6)	Greig et al. (1976)
" "	"	liver	W	(<0.5-<0.82)	"
Yellowfin tuna *Neothunnus macropterus*	Pacific	blood	A	45.0	Goldberg (1962)
" "	"	pyloric caeca	A	280.0	"
" "	"	muscle	A	130.0	"
" "	"	heart	A	25.0	"
" "	"	intestine	A	17.0	"
" "	"	liver	A	37.0	"
" "	"	integument	A	17.0	"
" "	"	stomach	A	260.0	"

Yellowfin tuna *Neothunnus macropterus*	Pacific	whole	A	19.0	Goldberg (1962)
Atlantic thread herring *Opisthonema oglinum*	Puerto Rico		W	(0.78-3.0) 1.9	Lowman et al. (1965, 1967)
" "	" "		D	(2.8-28.0) 7.2	"
" "	" "		A	(10.0-110.0) 38.0	Ting & Vega (1969)
Smelt *Osmerus eperlanus*	France	whole	W	0.015	Bertrand & Macheboeuf (1925)
" "	"	"	D	0.065	"
Calico bass *Paralabrax clathratus*	California	dorsal muscle	D	(5.0-6.4)	Stapleton (1968)
" "	"	ventral muscle	D	(5.8-6.1)	"
" "	"	gonad	D	(1.47-2.2)	"
" "	"	liver	D	(3.9-7.6)	"
" "	"	skin	D	(9.0-10.2)	"
White seaperch *Phanerodon furcatus*	Los Angeles harbor	muscle	D	9.0	Emerson et al. (1976)
Plaice *Pleuronectes platessa*	Great Britain	skin	W	6.0	Wright (1976)
" "	" "	stomach wall	W	4.6	"
" "	" "	fat body	W	4.2	"
" "	" "	liver	W	10.8	"
" "	" "	kidney	W	6.0	"

Plaice *Pleuronectes platessa*	Great Britain	muscle	W	2.8	Wright (1976)
" "	" "	gonad	W	9.0	"
Pollock *Pollachius virens* (= *Gadus virens*)	Russia		A	5.5	Malyuga (1946)
" "	"		D	1.1	"
" "	"		W	0.16	"
Bluefish *Pomatomus saltatrix*	Long Island		W	2.36	Zawacki & Briggs (1976)
" "	" "		D	5.8	"
Wenchman *Pristipomoides aquilonaris*	Texas	muscle	D	0.6	Horowitz & Presley (1977)
" "	"	skin	D	2.4	"
" "	"	viscera	D	4.2	"
Winter flounder, flatfish *Pseudopleuronectes americanus*	Texas	muscle	D	(0.6-7.4)3.3	"
" "	"	skin	D	(2.9-7.4)4.4	"
" "	New York Bight	muscle	W	(<0.3-0.5)	Greig & Wenzloff (1977)
" "	"	liver	W	(<0.3-<1.0)	"
Spanish sardine *Sardinella aurita*	Israel	muscle	D	(1.6-3.4)	Roth & Hornung (1977)
Sardine *Sardina pilchardus*		canned	W	0.21	Schroeder et al. (1962)

Sardine *Sardina pilchardus*	Adriatic Sea	skin	W	(1.1-5.8)2.5	Gilmartin & Revelante (1975)
" "	" "	gill	W	(0.2-0.9)0.7	"
" "	" "	muscle	W	(0.2-0.4)0.3	"
" "	" "	viscera	W	(0.3-1.7)0.8	"
" "	" "	liver	W	(ND-1.1)0.3	"
" "	" "	whole	W	(0.46-0.85)0.6	"
Lizard fish *Saurida undosquamis*	Israel	muscle	D	(0.3-10.8)	Roth & Hornung (1977)
Mackerel *Scomberomorus cavalla*	Puerto Rico		W	(0.19-2.5)1.0	Lowman et al. (1965)
" "	" "		D	(1.3-3.8)2.4	"
Window pane *Scophthalmus aquosus*	Long Island		W	1.17	Zawacki & Briggs (1976)
" "	" "		D	4.68	"
Amberjack *Seriola sp.*	Middle Atlantic	muscle	W	<0.5	Greig et al. (1976)
" "	"	liver	W	<1.2	"
Queenfish *Seriphus politus*	Los Angeles harbor	muscle	D	18.5	Emerson et al. (1976)
Blackear bass *Serranus atrobranchius*	Texas	muscle	D	1.5	Horowitz & Presley (1977)
" "	"	skin	D	4.9	"

Siganus rivulatus	Israel	muscle	D	0.7	Roth & Hornung (1977)
Sole *Solea vulgaris* (= Solea solea)	Israel	muscle	D	1.1	"
Barracuda *Sphyraena sphyraena*	Israel	muscle	D	(0.1-0.5)	"
Sprat *Sprattus sprattus* (= Clupea sprattus)	Great Britain	gill	W	4.5±SD 4.2	Wright (1976)
" "	" "	skin	W	9.2±SD 4.9	"
" "	" "	stomach	W	3.6±SD 1.2	"
" "	" "	liver	W	2.1±SD 1.0	"
" "	" "	fat body	W	2.0±SD 1.0	"
" "	" "	kidney	W	3.8±SD 2.2	"
" "	" "	muscle	W	7.2±SD 4.8	"
Spiny dogfish *Squalus acanthius*	Sweden		D	0.3	Noddack & Noddack (1940)
Longspined porgy *Stenotomus chrysops*	Texas	muscle	D	(0.5-2.0)1.0	Horowitz & Presley (1977)
" "	"	skin	D	(2.8-7.4)4.9	"
" "	"	viscera	D	3.5	"
Synophobranchus kaupi	Middle Atlantic Bight	whole	W	<0.49	Greig et al. (1976)
Albacore *Thunnus alalunga*	Pacific	spleen	A	42.0	Goldberg (1962)
" "	"	gall bladder	A	2400.0	"
" "	"	liver	A	10.0	"

Albacore Thunnus alalunga	Pacific	pyloric caeca	A	29.0	Goldberg (1962)
" "	"	stomach	A	17.0	"
" "	"	gill	A	7.0	"
" "	"	hyoid arch bone	A	11.0	"
Yellowfin tuna Thunnus albacares	Peru	muscle	W	2.0	Lowman et al. (1967)
" "	"	"	D	6.9	"
Rough scad Trachurus lathami	Texas	"	D	(0.7-1.1)0.9	Horowitz & Presley (1977)
" "	"	skin	D	(3.4-4.1)3.8	"
" "	"	viscera	D	2.5	"
Atlantic cutlass fish Trichiurus lepturus	Puerto Rico		W	(0.3-7.8)1.4	Lowman et al. (1966)
" "	" "		D	(1.5-25.0)4.7	"
Dwarf goatfish Upeneus molluccensis	Israel	muscle	D	(0.7-1.7)	Roth & Hornung (1977)
Red hake Urophycis chuss	New York Bight	muscle	W	(0.3-0.5)	Greig & Wenzloff (1977)
" "	" "	liver	W	(<0.2-1.7)	"
White hake Urophycis tenuis	" "	muscle	W	<0.1	"
Swordfish Xiphias gladius		frozen	W	0.02	Schroeder et al. (1962)

Viviparous blenny Zoarces viviparus	Great Britain	skin	W	10.6±SD 4.0	Wright (1976)
" "	" "	stomach wall	W	5.1±SD 1.3	"
" "	" "	liver	W	3.6±SD 2.0	"
" "	" "	muscle	W	3.12±SD 1.76	"
"Sea robin"	Texas	muscle	D	(0.5-1.2)0.8	Horowitz & Presley (1977)
" "	"	skin	D	(2.3-3.7)3.2	"
Eight demersal spp.	Great Britain	muscle	D	(2.1-3.5)	Halcrow et al. (1973)
Nine species	New Zealand	"	W	(0.02-0.07)	Brooks & Rumsey (1974)

NICKEL IN FRESHWATER FISH(1)

Species	Locality	Tissue	Analysis(2) PPM	Authority
Sturgeon *Acipenser sp.*	New York	muscle	W 0.03	Tong et al. (1972)
Rock bass *Ambloplites rupestris*	Ontario, Sudbury (contam.)	muscle	W 12.5	Hutchinson et al. (1975)
" "	"	liver	W 17.0	"
" "	"	kidney	W 17.3	"
" "	"	gill	W 31.7	"
Quillback *Carpiodes cyprinus*	Illinois	muscle	W (0.15-0.45)0.18	Mathis & Cummings (1973)
White sucker *Catostomus commersoni*	New York	muscle	W 0.09	Tong et al. (1972)
" "	Ontario, Sudbury (contam.)	muscle	W 13.2	Hutchinson et al. (1975)
" "	"	liver	W 16.5	"
" "	"	kidney	W 14.0	"
" "	"	gill	W 12.6	"

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Lake whitefish *Coregonus clupeaformis*	Manitoba, Moose Lake	muscle	W	<0.2	Uthe & Bligh (1971)
" "	Lake Ontario	"	W	<0.2	"
Carp *Cyprinus carpio*	New York	"	W	0.04	Tong et al. (1972)
" "	Illinois	muscle	W	(0.04-0.28) 0.19	Mathis & Cummings (1973)
Gizzard shad *Dorosoma cepedianum*	Illinois	muscle	W	(0.06-0.52) 0.28	Mathis & Cummings (1973)
Northern pike *Esox lucius*	Manitoba Moose Lake	muscle	W	<0.2	Uthe & Bligh (1971)
" "	Manitoba, Lake St. Pierre	muscle	W	<0.2	"
" "	Lake Erie	"	W	<0.2	"
" "	New York	muscle	W	(0.23-3.8)	Tong et al. (1972)
" "	Ontario, Sudbury (contam.)	muscle	W	13.3	Hutchinson et al. (1975)
" "	"	liver	W	15.4	"
" "	"	kidney	W	27.7	"
" "	"	gill	W	17.3	"
" "	Illinois	muscle	W	(0.08-0.19) 0.15	Mathis & Cummings (1973)
Muskellunge *Esox masquinongy*	New York	muscle	W	(0.19-1.3)	Tong et al. (1972)

Chain pickerel *Esox niger*	New York	muscle	W	(0.1-0.25)	Tong et al. (1972)
Yellow pickerel *Esox sp.*	Ontario, Sudbury (contam.)	muscle	W	13.8	Hutchinson et al. (1975)
" "	"	liver	W	14.4	"
" "	"	kidney	W	51.6	"
" "	"	gill	W	16.0	"
Brown bullhead *Ictalurus nebulosus*	"	muscle	W	9.5	"
" "	"	liver	W	10.7	"
" "	"	kidney	W	11.8	"
" "	"	gill	W	11.1	"
Bigmouth buffalo *Ictiobus cyprinellus*	Illinois	muscle	W	(0.02-0.18)0.10	Mathis & Cummings (1973)
Longnosed gar *Lepisosteus platostomus*	"	"	W	(0.07-0.28)0.18	"
Smallmouth bass *Micropterus dolomieui*	New York	"	W	(0.16-1.2)	Tong et al. (1972)
" "	Illinois	"	W	(0.08-0.19) 0.13	Mathis & Cummings (1973)
Largemouth bass *Micropterus salmoides*	New York	"	W	(0.18-1.9)	Tong et al. (1972)
" "	Illinois	"	W	(0.05-0.23)0.11	Mathis & Cummings (1973)
White bass *Morone chrysops*	Illinois	muscle	W	(0.04-0.12)0.08	"

Shorthead redhorse Moxostoma macrolepidnotum (=Moxostoma aureolum)	Ontario, Sudbury (contam.)	muscle		W	12.9	Hutchinson et al. (1975)
" "	"	liver		W	14.5	"
" "	"	kidney		W	14.1	"
" "	"	gill		W	12.2	"
" "	Illinois	muscle		W	(0.09-0.022) 0.14	Mathis & Cummings (1973)
Rainbow smelt Osmerus mordax	Lake Erie	muscle		W	<0.2	Uthe & Bligh (1971)
Yellow perch Perca flavescens	" "	"		W	<0.2	"
Black crappie Pomoxis nigromaculatus	New York	"		W	0.13	Tong et al. (1972)
Salmon Salmo sp.		liver		W	(0.14-0.28)	Schroeder et al. (1962)
Lake trout Salvelinus naymaycush	New York	muscle		W	(0.07-0.27)	Tong et al. (1972)
" "	" "	(no head or viscera)	age yrs.			Tong et al. (1974)
			1	W	0.0086	
" "	" "	" "	2	W	0.009	"
" "	" "	" "	3	W	0.0086	"
" "	" "	" "	4	W	0.009	"
" "	" "	" "	5	W	0.020	"
" "	" "	" "	6	W	0.0086	"
" "	" "	" "	7	W	0.022	"
" "	" "	" "	8	W	0.022	"

Lake trout *Salvelinus naymaycush*	New York	(no head or viscera)	age yrs.			Tong et al. (1974)
			9	W	0.011	
" "	" "	" "	10	W	0.022	"
" "	" "	" "	11	W	0.0072	"
" "	" "	" "	12	W	0.0023	"
Walleye *Stizostedion vitreum*	New York	muscle		W	(0.12-0.95)	Tong et al. (1972)

NICKEL IN MOLLUSCA(1)

Species	Locality	Tissue	Analysis(2) PPM	Authority
Aeolidia sp.		liver	D 8.0	(1931) in Vinogradov (1953)
Clam *Amblema plicata*	Illinois	soft parts	W (0.4-2.3)1.1	Mathis & Cummings (1973)
Anodonta sp.			trace	(1931) in Vinogradov (1953)
Aplysia sp.		liver	D 40.0	"
Archidoris tuberculata		"	D 0.0	Fox & Ramage (1930)
Ribbed horse mussel *Arculatula (Modiolus) modiolus*	Irish Sea	soft parts	W 1.95	Segar et al. (1971)
" " "	" "	"	D 9.4	"
Whelk *Buccinum undatum*	Great Britain	"	W 0.13	"
" "	" "	"	D 0.6	"

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Whelk *Buccinum undatum*	Scotland (sludge dump)	soft parts	D	8.5	Mackay et al. (1972)
Edible cockle *Cerastoderma edule* (= Cardium edule)	Great Britain	"	W	1.03	Segar et al. (1971)
" "	" "	"	D	7.9	"
" "		"	D	22.0	(1931) in Vinogradov (1953)
" "		"	W	0.0015	"
" "		"	D	0.007	"
" "		gill	W	1.755	"
" "		"	D	1.495	"
" "		hepato-pancreas	W	3.0	"
" "		"	D	23.45	"
" "		podium & sex organ	W	1.585	"
" "		" "	D	1.34	"
Scallop *Chlamys operculis*	Great Britain	soft parts	W	0.22	Bryan (1971)
" "	" "	renal organ	W	15.8	"
" "	" "	soft parts	W	0.21±0.055	Bryan (1973)
" "	" "	"	D	1.56±0.4	"
Scallop *Chlamys septemradiata*	Scotland (dump area)	"	D	16.0	Mackay et al. (1972)
South African black mussel *Choromytilis meridionalis*	South Africa	" (female)	D	5.2	Watling & Watling (1976b)
" "	" "	soft parts	D	(2.0-3.0)	"

South African black mussel *Choromytilis meridionalis*	South Africa	soft parts (male)	D	5.7	Watling & Watling (1976b)
Pteropod *Clione limacina*	New England	whole	A	4.0	Nicholls et al. (1959)
Corbicula leana	Japan	soft parts	D	(0.5-2.2)	Nagahiro et al. (1969)
" "	"	shell	D	(0.04-0.1)	"
Portuguese oyster *Crassostrea angulata*		gill	W	0.2	(1936) in Vinogradov (1953)
" "		"	D	1.295	"
" "		mantle	W	0.133	"
" "		"	D	0.935	"
" "		hepato-pancreas & sex organ	W	0.17	"
" "		"	D	1.0	"
Pacific oyster *Crassostrea gigas*	W. United States	soft parts	W	(0.10-0.20)	Pringle et al. (1968)
" "	South Africa	"	D	1.0	Watling & Watling (1976b)
" "	South Africa Knysna estuary	"	D	(1.6-2.0)	" (1976a)
" "	Great Britain	"	D	(1.0-10.0)	Thornton et al. (1976)
" "	" "	"	D	(3.8-6.5)	Boyden & Romeril (1974)
" "	" "	"	D	3.0	Boyden (1975)

Oyster *Crassostrea margaritacea*	South Africa Krysna		D	1.6	Watling & Watling (1976a)
" "	South Africa Langebaan lagoon		D	(<1.0-1.0)	"
American oyster *Crassostrea virginica*	E. United States	soft parts	W	(0.08-1.80) 0.19	Pringle et al. (1968)
" "	"	"	W	<0.12	Schuster & Pringle (1969)
" "	"	shell	D	<1.0	Smith & Wright (1962)
" "	"	soft parts	W	1.5	Schroeder et al. (1962)
Oyster *Crassostrea sp.*	France	"	D	1.74	(1925) in Vinogradov (1953)
" "	"	"	W	0.223	"
" "	"		D	6.0	"
Crepidula fornicata	Great Britain English Channel		W	127.5	Segar et al. (1971)
" "	" "		D	850.0	"
Clam *Fusconaia flava*	Illinois	soft parts	W	(0.7-3.0)2.1	Mathis & Cummings (1973)
Glycymeris glycymeris		"	D	1.4	Segar et al. (1971)
Red abalone *Haliotis rufescens*	California	gill	D	(68.6-111.5)	Anderlini (1974)
" "	"	mantle	D	(18.7-56.5)	"
" "	"	digestive gland	D	(2.5-10.6)	"

Red abalone *Haliotis rufescens*	California	foot	D	(0.0-1.6)	Anderlini (1974)
Abalone *Haliotis sp.*		foot	D	40.0	Fox & Ramage (1930)
Pteropod *Limacina retroversa*	New England	whole	A	2.0	Nicholls et al. (1959)
Macoma *Macoma nasuta*	California	soft parts	D	(6.5-19.2)	Emerson et al. (1976)
Northern quahog *Mercenaria mercenaria*	Great Britain	"	W	2.2	Segar et al. (1971)
" "	" "	"	D	11.0	"
" "	E. United States	"	W	(0.10-2.40) 0.24	Pringle et al. (1968)
Meretrix meretrix	Japan	"	D	(0.5-2.2)	Nagahiro et al. (1969)
" "	"	shell	D	(0.04-0.1)	"
Ribbed mussel *Modiolus modiolus*	Irish Sea	soft parts	D	133.0	Segar et al. (1971)
" "	" "	"	W	1.95	"
" "	" "	"	D	9.4	"
Soft-shell clam *Mya arenaria*	E. United States	"	W	(0.10-2.30) 0.27	Pringle et al. (1968)
" "		"	W	191.0	(1936) in Vinogradov (1953)
" "		"	D	960.0?	"
Ocean mussel *Mytilus californianus*	S. California	digestive gland	D	(3.0-20.0)	Alexander & Young (1976)

Mussel *Mytilus edulis aoteanus*	New Zealand	soft parts	D	(1.0-17.0) 7.0	Brooks & Rumsby (1965)
" " "	" "	mantle	D	<2.0	"
" " "	" "	gill	D	8.0	"
" " "	" "	muscle	D	<2.0	"
" " "	" "	visceral mass	D	32.0	"
" " "	" "	intestine	D	42.0	"
" " "	" "	foot	D	<2.0	"
" " "	" "	gonad	D	5.0	"
" " "	" "	shell	D	<2.0	"
Common mussel *Mytilus edulis edulis*	Great Britain	soft parts	W	0.41	Segar et al. (1971)
" " "	" "	"	D	3.7	"
" " "	France	"	D	2.35	(1925) in Vinogradov (1953)
" " "	"	"	W	0.455	"
" " "	Norway	"	D	(6.0-43.0)	Lande (1977)
" " "	"	shell	D	(6.0-8.0)	"
" " "	Russia		W	0.00048	Malyuga (1946)
" " "	"		D	0.0024	"
" " "	Greenland		W	(0.1-0.2)	Bollingberg (1975)
" " "	California	control soft parts	D	(11.0-14.0)	Friedrich & Filice (1976)
" " "	"	soft parts in 0.018 mg/l Ni	D	(16.0-20.0)	"

Common mussel *Mytilus edulis edulis*	Great Britain	soft parts	D	(5.0-12.0)	Boyden (1975)
" " (sp.?)	Naples Bay	"	D	6.6±1.6	Sheppard & Bellamy (1974)
" "	Great Britain	"	W	53.0	Wright (1976)
Mussel *Mytilus galloprovincialis*	N. W. Mediterranean	"	D	(0.9-14.1)4.3	Fowler & Oregioni (1976)
Mud snail *Nassarius fossatus*	California Los Angeles harbor	soft parts	D	36.2	Emerson et al. (1976)
Clam *Nucula sulcata*	Scotland	"	D	36.0	Mackay et al. (1972)
Herbivorous gastropod *Olivella biplicata*	S. California	"	D	1.8±1.7	Schwimer (1973)
" "	" "	shell	D	(15.2-17.5)	"
Squid *Ommastrephes illecebrosa*	New England		A	<1.0	Nicholls et al. (1959)
Squid *Onchoteuthis sp.*	N.E. Pacific Ocean		D	(0.13-0.19) Ni^{63} dis/mg/min.	Beasley & Held (1969)
Oyster *Ostrea edulis*	South Africa	soft parts	D	1.7	Watling & Watling (1976a)
" "	Great Britain	"	D	3.0	"
" "	" "	"	D	(2.0-5.0)	Boyden (1975)

Oyster Ostrea sinuata	New Zealand	soft parts	D	(1.0-3.0)2.0	Brooks & Rumsby (1965)
" "	" "	mantle	D	<2.0	"
" "	" "	gill	D	<2.0	"
" "	" "	muscle	D	8.0	"
" "	" "	striated muscle	D	<2.0	"
" "	" "	visceral mass	D	12.0	"
" "	" "	kidney	D	<2.0	"
" "	" "	heart	D	2.0	"
" "	" "	shell	D	<2.0	"
Paphia philippinarum	Japan	soft parts	D	(0.5-2.2)	Nagahiro et al. (1969)
" "	"	shell	D	(0.04-0.1)	"
Limpet Patella vulgata	Great Britain Irish Sea	soft parts	D	(3.1-24.0) 7.3 geom. mean	Preston et al. (1972)
" "	" "		W	0.45	Segar et al. (1971)
" "	" "		D	2.5	"
" "	Norway	soft parts	D	(4.0-11.0)	Lande (1977)
" "	"	shell	D	(3.0-7.0)	"
" "	Israel (sewage discharge)	soft parts	D	(11.7-11.9)	Navrot et al. (1974)
" "	Israel (other areas)	"	D	(5.2-8.5)	"

Limpet Patella vulgata	Israel (sewage discharge)	skeletal part	D	(6.4-6.5)	Navrot et al. (1974)
" "	Israel (other areas)	"	D	(5.7-6.8)	"
Scallop Pecten islandicus	Russia		W	0.045	Malyuga (1946)
" "	"		D	0.21	"
Scallop Pecten maximus		gill	W	148.0?	(1936) in Vinogradov (1953)
" "		"	D	160.0?	"
" "		hepato-pancreas	W	258.0?	"
" "		"	D	1280.0?	"
" "		foot & sex organ	W	54.0?	"
" "		" "	D	315.0?	"
" "	Great Britain	soft parts	W	13.9	Segar (1971)
" "	" "	"	D	49.0	"
" "	" "	"	W	0.09	Bryan (1973)
" "	" "	"	D	0.73	"
Scallop Pecten novaezelandiae	New Zealand		D	(2.0-17.0) 6.0	Brooks & Rumsby (1965)
" " "	" "	mantle	D	<2.0	"
" " "	" "	gill	D	68.0	"
" " "	" "	muscle	D	<2.0	"

Scallop Pecten novae-zelandiae	New Zealand	visceral mass	D	2.0	Brooks & Rumsby (1965)
" " "	" "	intestine	D	52.0	"
" " "	" "	kidney	D	106.0	"
" " "	" "	foot	D	22.0	"
" " "	" "	gonad	D	<2.0	"
" " "	" "	shell	D	<2.0	"
Pinna sp.		kidney	D	50.0	(1931) in Vinogradov (1953)
Giant scallop Placopecten magellanicus	N.E. Atlantic (ocean dump)	soft parts	D	(1.03-14.67) 4.41	Pesch et al. (1977)
Predatory gastropod Polineces lewisii	S. California	"	D	1.9±1.5	Schwimer (1973)
" "	" "	operculum	D	5.5±2.9	"
" "	" "	shell anterior	D	(16.4-16.9)	"
" "	" "	shell spire	D	(14.5-18.5)	"
" "	" "	shell posterior	D	(15.6-16.0)	"
Clam Quadrula quadrula	Illinois	soft parts	W	(0.4-1.6)0.9	Mathis & Cummings (1973)
Peppered semele Scrobicularia piperata			W	438.0?	(1936) in Vinogradov (1953)
" "			D	2,400.0?	"

Squid Stenoteuthis bartrami	N.E. Pacific		D	0.38 ± 0.24 Ni^{63}/dis/mg/min.	Beasley & Held (1969)
Giant clam Tridacne crocea	Penrhyn Atoll	kidney	D	0.8 ± 0.17 Ni^{63}/dis/mg/min.	"
" "	"	total kidney	D	4.0 mg.	"
Giant clam Tridacne gigas	Christmas Is.	kidney	D	0.8 ± 0.05 Ni^{63}/dis/mg/min.	"
" "	" "	total kidney	D	8.7 mg.	"
" "	Bikini Atoll	kidney	D	276.0 ± 3.0 Ni^{63}/dis/mg/min.	"
" "	" "	total kidney	D	3.8 mg.	"
Giant clam Tridacne sp.	Eniwetok Atoll	kidney	D	24.0 ± 0.2 Ni^{63}/dis/mg/min.	"
" "	"	total kidney	D	12.4 mg.	"
"Clam"	Ontario smelter area	soft parts	W	(4.0-29.0)	Hutchinson et al. (1975)
"Squid"	Texas	muscle	D	(1.0-4.3)2.5	Horowitz & Presley (1977)
"	"	viscera	D	(0.6-3.2)1.7	"
"	"	pen	D	0.8	"

NICKEL IN ARTHROPODA(1)

CRUSTACEA

Species	Locality	Tissue	Analysis(2) PPM	Authority
Calanoid copepod *Calanus finmarchius*	New England	whole	A 165.0	Nicholls et al. (1959)
" "	" "	"	D 29.0	"
" "	Russia	"	A 1.0	Malyuga (1939)
" "	"	"	W 0.011	"
" "	"	"	D 0.12	"
Ghost shrimp *Callianassa californiensis*	California		D (2.1-3.2)	Emerson et al. (1976)
Crab *Cancer anthonyi*	"	muscle	W (0.1-1.15)0.3	Fowler et al. (1975)
Rock crab *Cancer irroratus*	New York Bight	whole	D (1.7-4.4)	Greig et al. (1977)
Crab *Cancer pagurus*	Great Britain	"	W 9.8	Wright (1976)

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Green crab *Carcinus maenas*			D	0.12	Vinogradov (1953)
" "	Norway		D	11.0	Lande (1977)
" "	Great Britain	gill	W	6.70	Wright (1976)
" "	" "	muscle	W	6.20	"
" "	" "	hepato-pancreas	W	9.00	"
" "	" "	haemo-lymph	W	12.30	"
" "	" "	whole	W	6.50	"
Centropagus hamatus	New England		A	55.0	Nicholls et al. (1959)
Centropagus typicus	" "		A	55.0	"
Sand shrimp *Crangon allmani*	Scotland (control)	soft parts	D	15.0	Mackay et al. (1972)
" "	Scotland (dump area)	"	D	92.0	"
Sand shrimp *Crangon vulgaris*	Great Britain	muscle	W	8.80	Wright (1976)
Hermit crab *Eupagurus pubescens*	Russia		A	0.68	Malyuga (1939)
" "	"		D	0.05	"
" "	"		W	0.0097	"
Euphausid *Euphausia krohnii*	New England	whole	A	6.0	Nicholls et al. (1959)
Red crab *Geryon quinquedens*	Middle Atlantic Bight	muscle	W	<0.48	Greig et al. (1976)
" "	" "	gill	W	<0.50	"

Lobster Homarus americanus	United States	claw muscle	W	0.66	Schroeder et al. (1962)
Hyas araneus	Russia		A	1.8	Malyuga (1939)
" "	"		D	1.0	"
" "	"		W	0.2	"
Leander adspersus	"			trace	Petkevitch & Stepanyuk (1970)
Beach hopper Orchestoidea corniculata	California	whole	D	(ND-5.0)	Bender (1975)
Beach hopper Orchestoidea californiana	"	"	D	(ND-5.0)	"
Prawn Pandalus montagui	Scotland (control)	soft parts	D	25.0	Mackay et al. (1972)
" "	Scotland (dump area)	"	D	70.0	"
Spiny lobster Panulirus argus	Puerto Rico		W	27.0	Lowman et al. (1965)
" "	" "		D	50.0	"
" "	Puerto Rico Anasco Bay		W	(1.0-2.0)1.3	Lowman et al. (1967)
" "	" "		D	(8.0-9.0)4.5	"
" "	Puerto Rico West coast		W	(1.4-5.0)4.6	Lowman et al. (1965)
" "	" "		D	(22.0-60.0) 35.8	"
Spiny lobster Panulirus sp.	France	without carapace	W	0.1	Bertrand & Macheboeuf (1925)

Spiny lobster *Panulirus sp.*	France	without carapace	D	0.435	Bertrand & Macheboeuf (1925)
Brown shrimp *Penaeus aztecus*	Texas	muscle	D	(0.3-1.9) 1.4	Horowitz & Presley (1977)
" "	"	exoskeleton	D	(2.7-17.9)6.2	"
" "	"	viscera	D	(5.6-5.8)5.7	"
Copepod *Pleuromamma xiphias*	Puerto Rico		A	(60.0-340.0)	Martin (1970)
Copepod *Undinula vulgaris*	" "		A	(45.0-230.0)	"
Sea bob *Xiphopenaeus kroyeri*	" "		W	(2.0-7.0)5.1	Lowman et al. (1967)
"Copepods"	Long Island Sound		D	4.5	Greig et al. (1977)
"Crayfish"	Ontario (smelter area)		W	(5.0-39.0)	Hutchinson et al. (1975)
"Rock shrimp"	Texas	muscle	D	(0.8-3.3) 1.6	Horowitz & Presley (1977)
" "	"	exoskeleton	D	(3.9-6.9)5.8	"
Zooplankton	Long Island Sound		D	(0.9-3.6)	Greig et al. (1977)

NICKEL IN ARTHROPODA

INSECTA

Moth *Bombyx mori*	France	pupae	D	"uncertain"	Bertrand & Macheboeuf (1925)

Beach fly *Coelopa vanduzeei*	California	whole	D	(ND-7.0)	Bender (1975)
Beach fly *Fucellia rufitibia*	"	"	D	(ND-7.0)	"
Termite *Odontotermes transvaalensis*	Rhodesia	worker	D	5,000.0	Wild (1975)
" "	"	soldier	D	100.0	"
" "	"	queen	D	20.0	"
Termite *Trinervitermes dispar*	"	worker	D	5,000.0	"
" "	"	soldier	D	100.0	"

NICKEL IN ECHINODERMATA(1)

Species	Locality	Tissue	Analysis(2) PPM	Authority
Urchin Arbacia lixula	Italy, Naples	soft parts	(10.8-15.4)	Sheppard & Bellamy (1974)
Starfish Asterias rubens	Sweden		D 24.0	Noddack & Noddack (1940)
" "	Russia		D 4.0	Malyuga (1941)
" "	Great Britain	digestive part	high conc.	Riley & Segar (1970)
" "	" "	gonad	less. conc.	"
" "	" "	skeleton	low conc.	"
Sea urchin Brissopsis lyrifera	Sweden		D 2.1	Noddack & Noddack (1940)
Sea cucumber Cucumaria frondosa	Russia		D 2.0	Malyuga (1946)

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Sea urchin _Echinometra lucunter_	Puerto Rico		D 36.84	Stevenson et al. (1966)
" "	" "	skeleton	D (42.0-78.0) 51.0	Stevenson & Ufret (1966)
Sea urchin _Echinus esculentus_	Great Britain	digestive part	high conc.	Riley & Segar (1970)
" "	" "	gonad	less conc.	"
" "	" "	skeleton	low conc.	"
Sand dollar _Mellita lata_	Puerto Rico		W (20.0-26.0) 22.0	Lowman et al. (1966)
" "	" "		D (34.0-45.0) 39.0	"
Sea cucumber _Ophiothrix suensoni_	" "		W 15.93	Stevenson et al. (1966)
Sea star _Pisaster brevispinus_	California	ray	D (12.0-14.0)	Schwimer (1973)
Sea urchin _Spatangus purpureus_	Great Britain	digestive part	high conc.	Riley & Segar (1970)
" "	" "	gonad	less conc.	"
" "	" "	skeleton	low conc.	"
Sea cucumber _Stichopus tremulans_	Sweden		D 38.0	Noddack & Noddack (1940)
Sea urchin _Tripneustes esculentus_	Puerto Rico	testis	W 21.59	Stevenson et al. (1966)
" "	" "	ovary	W 1.39	
" "	" "	skeleton	D (18.0-54.0) 35.0	Stevenson & Ufret (1966)

NICKEL IN LOWER INVERTEBRATES(1)

PORIFERA

Species	Locality	Tissue	Analysis(2) PPM	Authority
Sponge *Halichondra sp.*	Sweden		D ?2.0	Noddack & Noddack (1940)

NICKEL IN LOWER INVERTEBRATES

COELENTERATA

Species	Locality	Tissue	Analysis(2) PPM	Authority
Coral *Anomocora fecunda*	Jamaica		D 2.0	Livingston & Thompson (1971)
Coral *Bathycyanthus maculatus*	"		D 2.0	"
Coral *Caryophyllia clavus*	"		D 2.0	"
Coral *Caryophyllia communis*	"		D 3.0	"
Cerianthus sp.	California	whole	D 3.1	Emerson et al. (1976)

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Coral Cladocera patriarca	Jamaica		D	2.0	Livingston & Thompson (1971)
Lions mane Cyanaea capillata	Sweden	whole	D	30.0	Noddack & Noddack (1940)
" "	New England	"	D	0.6	Nicholls et al. (1959)
" "	" "	"	A	<1.0	"
Coral Dendrophyllia sp.	Jamaica		D	2.0	Livingston & Thompson (1971)
Coral Desmophyllum cristogalli	"		D	(2.0-3.0)	"
Coral Eusmilia fastigiata	Puerto Rico		W	(48.0-57.0) 52.0	Lowman et al. (1966)
" "	" '		D	(48.0-58.0) 53.0	"
Coral Madracis asperula	Jamaica		D	7.0	Livingston & Thompson (1971)
Coral Madracis mirabilis	"		D	(<2.0-2.0)	"
Coral Madracis pharensis	"		D	2.0	"
Coral Meandrina areolata	"		D	<2.0	"
Coral Meandrina braziliensis	"		D	<2.0	"
Coral Meandrina neandrites	Puerto Rico		W	(35.0-43.0) 38.5	Lowman et al. (1966)

Sea anemone Metridium dianthus	Sweden		D	23.0	Noddack & Noddack (1940)
Coral Montastrea annularis	Jamaica		D	(<2.0-3.0)	Livingston & Thompson (1971)
Gorgonian Muricea atlantica	Puerto Rico		D	25.0	Lowman et al. (1966)
Coral Porites porites	Jamaica		D	(<2.0-2.0)	Livingston & Thompson (1971)
Coral Phyllangia americana	"		D	2.0	"
Gorgonian Pseudapterygorgia americana	Puerto Rico		D	(10.0-60.0)	Lowman et al. (1966)
Coral Scolmia cubensis	Jamaica		D	3.0	Livingston & Thompson (1971)
Coral Solenosmilia variabilis	"		D	(<2.0-23.0)	"
Coral Trochocyanthus sp.	"		D	3.0	"
Jellyfish	New York Bight	whole	D	<2.8	Greig et al. (1977)

NICKEL IN LOWER INVERTEBRATES

CTENOPHORA

Comb jelly Beroe cucumis	New England		A	<1.0	Nicholls et al. (1959)
Comb jellyfish	New York Bight	whole	D	(1.7-<2.8)	Greig et al. (1977)

NICKEL IN LOWER INVERTEBRATES
CHAETOGNATHA

Arrow worm Sagitta elegans	New England		A	480.0	Nicholls et al. (1959)
" "	NE Pacific Ocean		D	(0.93-4.5) Ni^{63} dis/mg/min.	Beasley & Held (1969)

NICKEL IN LOWER INVERTEBRATES
TUNICATA

Cione intestinalis	Sweden		D	16.0	Noddack & Noddack (1940)
" "	California	tunic	D	31.7	Emerson et al. (1976)
" "	"	internal organs	D	13.2	"
Salp Salpa fusiformis	New England		A	60.0	Nicholls et al. (1959)
Manicina areolata	Puerto Rico		W	(53.0-54.0) 54.0	Lowman et al. (1966)

NICKEL IN LOWER INVERTEBRATES
ANNELIDA

Earthworm Alloloborphora chlorotica	Maryland	whole	D	(12.9-37.5)	Gish & Christensen (1973)
Allolobophora trapezoides	"	"	D	(12.9-37.5)	"

Allolobophora turgida	Maryland	whole	D	(12.9-37.5)	Gish & Christensen (1973)
Aphrodite aculeata			D	30.0	(1931) in Vinogradov (1953)
Sandworm Arenicola marina	Gulf of Kola		A	18.0	Malyuga (1946)
" "	" " "		D	11.0	"
" "	" " "		W	3.9	"
Sandworm Arenicola sp.			D	8.0	(1931) in Vinogradov (1953)
Audouinia tentaculata			D	14.0	"
Polychaete Cirriformia luxuriosa	California	whole	D	(9.8-13.1)	Emerson et al. (1976)
Palolo worm Eunice sp.	Puerto Rico		W	(12.86-14.43) 13.6	Stevenson et al. (1966)
Tubificid worm Limnodrilus hoffmasteri	Illinois	whole	W	(4.0-18.0)	Mathis & Cummings (1973)
Earthworm Lumbricus terrestris	Maryland	whole	D	(12.9-37.5)	Gish & Christensen (1973)
Lumbrineris sp.	California	whole	D	3.5	Emerson et al. (1976)
Myxicola infundibulum			D	(100.0-800.0)?	(1931) in Vinogradov (1953)
Polychaete Notomastus tenuis	California	whole	D	7.8	Emerson et al. (1976)

Polychaete _Sigambra tentacula_	California	whole	D	(3.8-18.7)	Emerson et al. (1976)
Spirographis spallanzanii			D	8.0	(1931) in Vinogradov (1953)
Tubificid worm _Tubifex tubifex_	Illinois	whole	W	(4.0-18.0)	Mathis & Cummings (1973)

NICKEL IN HIGHER PLANTS(1)

Species	Locality	Tissue	Analysis(2) PPM	Authority
Norway maple *Acer platanoides*	Connecticut	leaf	D (0.05-15.0) 6.0±SE 0.6	Smith (1973)
" "	"	twig	D (0.05-6.0) 2.0±SE 0.3	"
Red maple *Acer rubrum*	Ontario, Sudbury Distance from smelter: Km	leaf		Hutchinson & Whitby (1973)
" "	" " " 1.7N	"	D 123.0	"
" "	" " " 1.7S	"	D 98.0	"
" "	" " " 2.1	"	D 88.0	"
" "	" " " 7.4	"	D 45.0	"
" "	" " " 10.4	"	D 10.0	"
" "	" " " 13.4	"	D 33.0	"
" "	" " " 20.4	"	D 57.0	"
" "	" " " 39.0	"	D 14.0	"
" "	" " " 52.7	"	D 14.0	"

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Sugar maple Acer saccharum	Connecticut	leaf	D	(9.0-28.0) 14.0±SE 2.0	Smith (1973)
" "	"	twig	D	(8.0-17.0) 11.0±SE 1.0	"
" "	New Hampshire & Vermont	leaf & twig	D	(0.3-21.0)	"
Quackgrass Agropyron repens	New Hampshire		D	(2.0-3.0)	Iskander (1975)
Bent grass Agrostis stolonifera	Scotland serpentine	shoot	A	(201.0-439.)	Shewry & Peterson (1976)
" "	Austria chromite mine	shoot	A	(178.0-214.0)	"
Onion Allium cepa	Toronto, on muck soil	leaf, spring	D	9.4	Hutchinson et al. (1974)
" "	" " "	leaf, fall	D	3.8	"
" "	" " "	root, spring	D	18.4	"
" "	" " "	root, fall	D	10.9	"
" "	" " "	bulb, fall	D	2.9	"
" "		bulb	D	0.16	Vanselow (1966)
Allysum Allysum spp.		Of 166 species analysed, 44 species were hyper-accumulators with >1000 ppm (0.1%) Ni in dry leaves.			Brooks et al. (1978)
Allysum Allysum alpestre	Europe	leaf	D	3,600	Brooks & Radford (1978)

Allysum Allysum bertolonii	Italy, serpentine	leaf (NiO)	A	100,000.0 hyperaccumulator	Minguzzi & Vergnano (1948)
" "	"	"	D	20,400 (max.)	"
" "	"	"	D	12,200	"
" "	"	root	D	3,100	"
" "	"	flower	D	5,400	"
" "	"	fruit	D	5,800	"
" "	"	seed	D	6,100	"
" "	"	stem	D	13,500 (max.)	Vergnano Gambi (1965)
" "		Is accumulator plant used for Ni prospecting			Cannon (1971)
Allysum Allysum corsicum	Europe	leaf	D	13,500	Brooks & Radford (1978)
Allysum Allysum euboeum	Europe	leaf	D	4.600	"
Allysum Allysum fallacinum	"	"	D	4,000	"
Allysum Allysum heldreichii	"	"	D	12,500	"
Allysum Allysum markgrafii	"	"	D	13,700	"
Allysum Allysum murale	Russia	leaf	A	> 100,000	Doksopulo (1961)
" "	"	accumulator plant			Malyuga (1964)
Allysum Allysum obovatum	Europe	leaf	D	4,000	Brooks & Radford (1978)

Allysum Allysum robertianum	Europe	leaf	D	12,500	Brooks & Radford (1978)
Allysum Allysum serpyllifolinum ssp. lusitanicum	N.E. Portugal	leaf	A	103,000	Menezes de Sequeira (1968)
" " " "	" "	"	D	5,200	"
Allysum Allysum smolikanum	Europe	"	D	6,600	Brooks & Radford (1978)
Allysum Allysum tenium	"	"	D	3,400	"
Pigweed Amaranthus hybridus	New Jersey	leaf & stem		(0.3-1.4)	Painter et al. (1953)
Pigweed Amaranthus retroflexus	" "	"		0.9	"
Ragweed Ambrosia artemisiifolia	" "	"		1.4	"
Elodea Anacharis canadensis	Ontario (contam.)	leaf & stem	W	(18.0-510.0)	Hutchinson et al. (1975)
Celery Apium graveolans	Toronto, muck	leaf, spring	D	36.4	Hutchinson et al. (1974)
" "	"	leaf, fall	D	5.0	"
" "	"	root, spring	D	32.1	"
" "	"	root, fall	D	3.2	"
" "	United States	stem	W	0.37	Schroeder et al. (1962)

Sea pink *Armeria maritima*	Scotland, serpentine	shoot	A	(1041-3199)	Shewry & Peterson (1976)
" "	Scotland, non-serpentine	"	A	35.0	"
" "	Austria, chromite mine	"	A	201.0	"
Big sagebrush *Artemisia tridentata*	Nevada	stem	D	(2.0-4.0)	Wallace & Romney (1972)
" "	"	leaf	D	(5.0-11.0)	"
Big sagebrush *Artemisia tridentata ssp. tridentata*	Idaho (3 km downwind from phosphate factories)	branch & flower	D	(15.0-30.0)	Gough & Severson (1976)
" " "	" " " "	"	D	(28.0-48.0)	"
Spleenwort *Asplenium ruta-muraria*	Austria, serpentine	shoot	A	581.0	Shewry & Peterson (1976)
Salt bush *Atriplex canescens*	Nevada in desert	leaf	D	(1.3-4.0)	Wallace & Romney (1972)
" "	Nevada, low salt	leaf	D	(4.3-4.5)	"
" "	Nevada, high salt	leaf	D	(4.3-6.0)	"
Salt bush *Atriplex confertifolia*	Nevada, in nutrient soln.	leaf	D	(1.6-5.9)	"
" "	" " "	stem	D	(2.2-6.4)	"
" "	" " "	root	D	(1.0-8.1)	"

Salt bush *Atriplex confertifolia*	Nevada, in desert	leaf	D	(0.5-2.4)	Wallace & Romney (1972)
" "	Nevada, low salt	"	D	(6.9-8.6)	"
" "	Nevada high salt	"	D	(4.0-5.8)	"
Salt bush *Atriplex hymenelytra*	Nevada, in desert	leaf	D	(0.7-1.6)	"
" "	Nevada, low salt	"	D	(3.7-4.7)	"
" "	Nevada, high salt	"	D	(2.4-4.7)	"
Oats *Avena sativa*	Scotland, serpentine soil	Stunted from Ni excess			Cannon (1969)
" "	United States	seed	W	(1.71-2.6)	Schroeder et al. (1962)
" "	" "	"	D	0.45	Vanselow (1966)
Becium homblei	Rhodesia		D	171.0	Wild (1970)
Becium obovatum	"		D	261.0	"
Daisy *Bellis perennis*	New Zealand (along highway)	root	D	0.7	Ward et al. (1977)
" "	"	leaf	D	1.5	"
Beet *Beta vulgaris*	United States	"	W	1.94	Schroeder et al. (1962)
" "	New Jersey	"		1.7	Painter et al. (1953)
" "	" "	root		0.4	"

Swiss chard Beta vulgaris cicla	United States	leaf	W	0.71	Schroeder et al. (1962)
Paper birch Betula papyrifera	Ontario (June) dist. from smelter(mi.):				Hutchinson & Whitby (1974)
" "	" " 1.0	leaf	D	157.9	"
" "	" " 4.6	"	D	82.0	"
" "	" " 6.5	"	D	10.3	"
" "	" " 8.4	"	D	41.0	"
" "	" " 12.0	"	D	65.6	"
" "	" " 18.0	"	D	20.5	"
" "	" " 31.0	"	D	61.5	"
	(August)				
" "	" " 1.0	"	D	147.6	"
" "	" " 4.6	"	D	110.7	"
" "	" " 6.5	"	D	100.5	"
" "	" " 8.4	"	D	71.8	"
" "	" " 12.0	"	D	63.6	"
" "	" " 18.0	"	D	34.9	"
" "	" " 31.0	"	D	16.4	"
Blepharis bainessi	Rhodesia		D	625.0	Wild (1970)
Cabbage Brassica oleracea capitata		head	D	3.3	Vanselow (1966)
" " "	Toronto, muck	leaf, spring	D	39.7	Hutchinson et al. (1974)
" " "	"	leaf, fall	D	6.2	"

Cabbage *Brassica oleracea capitata*	Toronto, muck	root spring	D	72.6	Hutchinson et al. (1974)
" " "	"	root, fall	D	5.9	"
" " "	United States	head	W	(0.14-0.32)	Schroeder et al. (1962)
" " "	New Jersey	"		0.5	Painter et al. (1953)
Kale *Brassica oleracea acephala*	United States	"organic"	W	1.12	Schroeder et al. (1962)
" " "	Alabama	leaf		1.8	Giordano & Mays (1977)
Cauliflower *Brassica oleracea botrytis*	Toronto	leaf, spring	D	14.0	Hutchinson et al. (1974)
" " "	"	leaf, fall	D	3.5	"
" " "	"	root, spring	D	15.7	"
" " "	"	root, fall	D	3.7	"
" " "	"	head, fall	D	3.1	"
" " "	United States	leaf	W	0.19	Schroeder et al. (1962)
" " "	New Jersey	head		0.4	Painter et al. (1953)
Kohlrabi *Brassica oleracea gongylodes*	United States	leaf	W	0.47	Schroeder et al. (1962)
Broccoli *Brassica oleracea italica*	United States		W	0.33	"

Turnip *Brassica rapa*	Alabama	leaf		2.9	Giordano & Mays (1977)
" "	"	root		1.8	"
Scotch heather *Calluna vulgaris*	Scotland, serpentine	shoot	A	(825.0-1923.0)	Shewry & Peterson (1976)
" "	Austria chromite mine	"	A	849.0	"
Tea *Camellia sinensis*		orange pekoe	W	7.6	Schroeder et al. (1962)
" "		Chinese	W	(0.51-0.65)	Karvanek (1964)
Chile pepper *Capsicum annuum*	Australia Cu smelter		D	0.9	Beavington (1975)
Bush red pepper *Capsicum frutescens*	New Jersey	plant		1.7	Painter et al. (1953)
" "	" "	fruit		1.0	"
" " (sp?)	Alabama	"		(1.0-1.5)	Giordano & Mays (1977)
" "	"	leaf		(1.7-2.3)	"
Hickory *Carya sp.*	Tennessee		D	(5.0-50.0)	Van Hook et al. (1974)
Cassinia vauvilliersii	New Zealand	leaf	A	(<20.0-1425.0)	Lyon et al. (1971)
Cassinia vauvilliersii var. serpentina	" "	"	A	2,000.0	Lyon & Brooks (1970)
Chickweed *Cerastium holosteoides*	Scotland, serpentine	shoot	A	1662.0	Shewry & Peterson (1976)

Chickweed Cerastium holosteoides	Austria chromite mine	shoot	A 270.0	Shewry & Peterson (1976)
Chickweed Cerastium nigrescens	Scotland, serpentine	shoot	A 1266.0	"
Chickweed Cerastium sp.	Sunn-more, serpentine		stunted and differentiated	Cannon (1969)
Lip fern Cheilanthes marantae	Austria, serpentine	shoot	A 345.0	Shewry & Peterson (1976)
Lambs quarters Chenopodium album	New Jersey		0.5	Painter et al. (1953)
Rabbit bush Chrysothamnus viscidiflorus	Nevada	leaf	D 2.0	Wallace & Romney (1972)
" "	"	stem	D 2.0	"
Chicory Cichorium intybus	United States		W 0.55	Schroeder et al. (1962)
Cinnamon Cinnamomum zeylandicum			W 0.74	"
Orange Citrus sinensis			D 0.16	Bertrand & Mokragnatz (1930)
Coffee Coffea arabica		bean, green	W (0.1-0.26)	Karvanek (1964)
Black brush Coleogyne ramosissima	Nevada	grown, leaf	D (3.1-4.9)	Wallace & Romney (1972)
" "	Nevada, in desert	leaf	D (0.7-12.0)	"

Black brush *Coleogyne ramosissima*	Nevada, in desert		stem	D	(1.2-18.7)	Wallace & Romney (1972)
Sweet fern *Comptonia peregrina*	Ontario (June) dist. from Ni smelter (mi.):					Hutchinson & Whitby (1974)
" "	" "	1.0	leaf	D	112.8	"
" "	" "	1.4	"	D	243.4	"
" "	" "	6.5	"	D	13.0	"
" "	" "	8.4	"	D	73.8	"
" "	" "	12.0	"	D	58.6	"
" "	" "	18.0	"	D	28.2	"
" "	" "	31.0	"	D	17.4	"
	(August)					
" "	" "	1.0	"	D	173.6	"
" "	" "	1.4	"	D	164.9	"
" "	" "	4.6	"	D	89.0	"
" "	" "	6.5	"	D	45.6	"
" "	" "	8.4	"	D	47.7	"
" "	" "	12.0	"	D	43.4	"
" "	" "	18.0	"	D	34.7	"
" "	" "	31.0	"	D	15.2	"
Dwarf dogwood, bunchberry *Cornus canadensis*	Ontario (June) dist. from Ni smelter (mi):					
" "	" "	8.4	leaf	D	47.7	"
" "	" "	12.0	"	D	36.9	"
" "	" "	18.0	"	D	19.5	"

Dwarf dogwood, bunchberry *Cornus canadensis*	Ontario (August) dist. from Ni smelter (mi):				Hutchinson & Whitby (1974)
" "	" " 6.5	leaf	D	67.3	"
" "	" " 8.4	"	D	47.7	"
" "	" " 12.0	"	D	34.7	"
" "	" " 18.0	"	D	21.7	"
Hawksbeard *Crepis sp.*	New Zealand (along highway)	root	D	1.8	Ward et al. (1977)
" "	" "	leaf	D	3.1	"
Squash *Curcurbita pepo*			D	4.6	Vanselow (1966)
" "	Alabama	fruit		(0.9-1.5)	Giordano & Mays (1977)
" "	"	leaf		(1.7-2.6)	"
Dodder *Cuscuta nevadensis*	Nevada, in desert	whole plant	D	(0.5-1.2)	Wallace & Romney (1972)
Cocksfoot, orchard grass *Dactylis glomerata*	New Zealand (along highway)	root	D	2.0	Ward et al. (1977)
" "	" "	leaf	D	0.7	"
" "	New Jersey	leaf & stem		1.6	Painter et al. (1953)
Carrot *Daucus carota*	Toronto, muck	spring leaf	D	12.7	Hutchinson et al. (1974)
" "	"	fall leaf	D	4.4	"
" "	"	spring root	D	16.9	"

Carrot Daucus carota	Toronto, muck	fall root	D	2.5	Hutchinson et al. (1974)
" "		leaf	D	1.8	Vanselow (1966)
" "		root	D	0.3	"
" "	New Jersey	"		0.4	Painter et al. (1953)
" "	" "	top		1.0	"
Wavy hair grass Deschampsia flexuosa	Sweden (in spruce forest contaminated by industry)	leaf	D	12.0	Tyler (1972)
" "	" " "	leaf litter	D	14.0	"
" "	" " "	root & rhizome	D	13.0	"
" "	Ontario dist. from Ni smelter (km):				Hutchinson & Whitby (1973)
" "	" " 1.7	leaf	D	902.0	"
" "	" " 2.1	"	D	242.0	"
" "	" " 7.4	"	D	160.0	"
" "	" " 10.4	"	D	14.0	"
" "	" " 13.4	"	D	138.0	"
" "	" " 20.4	"	D	43.0	"
" "	" " 52.7	"	D	37.0	"
Dicoma macrocephala ssp. niccolifera	Rhodesia		D	1,401.0	Wild (1970)
" " "			Is good Ni indicator		"
Dicoma niccolifera	Rhodesia serpentine		A	28,000	Wild (1971)

Dicoma niccolifera	Rhodesia, serpentine		D	2,100	Wild (1971)
Crab grass *Digitaria sanguinalis*	New Jersey	leaf & stem		1.5	Painter et al. (1953)
Cloves *Eugenia aromatica*		whole	W	0.1	Schroeder et al. (1962)
Mormon tea *Ephedra funerea*	Nevada	shoot	D	(trace-4.0)	Wallace & Romney (1972)
Mormon tea *Ephedra nevadensis*	Nevada	shoot	D	(trace-7.0)	"
Mormon tea *Ephedra torreyana*	Nevada	shoot	D	(2.0-4.0)	"
Mormon tea *Ephedra viridis*	Nevada	shoot	D	(7.0-12.0)	"
Horsetail *Equisetum palustre*	Ontario smelter contam.	root	W	(24.0-290.0)	Hutchinson et al. (1975)
" "	"	stem	W	(8.0-165.0)	"
Horsetail *Equisetum sp.*	Ontario (June) dist. from Ni smelter (mi):				Hutchinson & Whitby (1974)
" "	" " 1.0		D	124.8	"
" "	" " 1.0		D	67.3	"
" "	" " 1.4		D	156.2	"
" "	" " 6.5		D	15.2	"
" "	" " 12.0		D	56.4	"
	(August)				
" "	" " 1.0		D	69.4	"
" "	" " 1.0		D	274.7	"

Horsetail *Equisetum sp.*	Ontario (August) dist. from Ni smelter (mi):				Hutchinson & Whitby (1974)
" "	" " 1.4		D	255.5	"
" "	" " 4.6		D	359.1	"
" "	" " 12.0		D	19.5	"
Winterfat *Eurotia lanata*	Nevada, grown	leaf	D	(trace-4.0)	Wallace & Romney (1972)
" "	"	"	D	(6.3-12.0)	"
" "	Nevada in desert	leaf	D	(trace-2.9)	"
" "	" " Pahute Mesa	"	D	93.0	"
" "	" "	stem	D	(trace-1.1)	"
" "	" " " "	"	D	34.0	"
Buckwheat *Fagopyron sagittatum*	United States	seed	W	6.45	Schroeder et al. (1962)
" "		"	D	1.34	Vanselow (1966)
Fescue *Festuca ovina*	Scotland, serpentine	shoot	A	773.0	Shewry & Peterson (1976)
Red fescue grass *Festuca rubra*	Wales dist. from industrial area (km):				Goodman & Roberts (1971)
" "	" " 1.5		D	15.0	"
" "	" " 3.0		D	15.0	"
" "	" " 5.0		D	20.0	"
" "	" " 6.0		D	82.0	"

Red fescue grass *Festuca rubra*	Wales dist. from industrial area (km):				Goodman & Roberts (1971)
" "	" " 16.0		D	7.0	"
" "	" " 16.0		D	8.0	"
" "	control 6.5		D	6.0	"
" "	upwind 18.0		D	8.0	"
" "	Scotland serpentine	shoot	A	(314.0-481.0)	Shewry & Peterson (1976)
" "	Austria chromite mine	"	A	(246.0-341.0)	"
" "	Wales	"	D	(6.0-11.0)7.3 ±SE 0.96	Roberts & Goodman (1973)
Fescue *Festuca vivipara*	Scotland, serpentine	shoot	A	301.0	Shewry & Peterson (1976)
Tall fescue *Festuca sp.*	Maryland highway roadsides, m from road:				Lagerwerff & Specht (1970)
" "	" " 8	shoot	D	(3.8-5.0)	"
" "	" " 16	"	D	(2.5-3.8)	"
" "	" " 32	"	D	(1.3-2.8)	"
Fig *Ficus carica*		fruit	D	1.2	Bertrand & Mokragnatz (1930)
Burro bush *Franseria dumosa*	Nevada in desert	leaf	D	(1.0-9.4)	Wallace & Romney (1972)

Burro bush *Franseria dumosa*	Nevada seasonal	leaf	D	(0.9-3.0)	Wallace & Romney (1972)
" "	"	stem	D	(trace-2.7)	"
Geissois pruinosa	New Caledonia	leaf	D	8,000 (max)	Jaffre & Schmid (1974)
Geissois spp.	" "	6 other species are Ni hyperaccumulators			Jaffre & Brooks (1978)
Gentian *Gentiana corymbifera*	New Zealand		A	1,300.0	Lyon & Brooks (1970)
Spiny hop sage *Grayia spinosa*	Nevada, grown in desert	leaf	D	(1.8-8.7)	Wallace & Romney (1972)
" "	Nevada, greenhouse	leaf	D	(0.7-8.6)	"
Borage *Halaesyna sp.*	on serpentine		stunted and differentiated		Cannon (1969)
Hebe odora	New Zealand	leaf	A	(29.0-1,880.0)	Lyon et al. (1971)
" "	" "		A	2,600.0	Lyon & Brooks (1970)
Okra *Hibiscus esculentus*	Alabama	fruit		0.7	Giordano & Mays (1977)
" "	"	leaf		1.9	"
Yorkshire fog *Holcus lanatus*	New Zealand along highway	root	D	2.8	Ward et al. (1977)
" "	" "	leaf	D	3.3	"

Homalium austrocaledonicum	New Caledonia	leaf	D	1,800	Brooks et al. (1977a)
Homalium decurrens	" "	"	D	180.0	"
Homalium deplanchii	" "	"	D	1,900	"
Homalium francii	" "	"	D	14,500	"
Homalium guillainii	" "	"	D	29,000	Jaffre & Schmid (1974)
Homalium kanaliense	" "	"	D	9,000	Brooks et al. (1974)
Homalium le-ratiorum	" "	"	D	640	Brooks et al. (1977a)
Homalium mathieuanum	" "	"	D	1,700	"
Homalium rubiginosum	" "	"	D	400	"
Homalium rubrocostatum	" "	"	D	1,200	"
Homalium serratum	" "	"	D	100	"
Barley Hordeum vulgare			D	(4.0-6.0)	Vanselow (1966)
Hybanthus austro-caledonicus	" "		A	270,000	Brooks et al. (1974)
" " "	New Caledonia (on peridotites)		A	132,000	Kelly et al. (1975)
" " "	" "		D	14,600	"
" " "	New Caledonia	leaf	D	18,500	Jaffre & Schmid (1974)
" " "	" "	useful for biogeochemical prospecting			Lee et al. (1977a)
Hybanthus caledonicus form A, large leaf	New Caledonia on serpentine		A	110,000	Kelly et al. (1975)

Hybanthus caledonicus form A, large leaf	New Caledonia on serpentine		D	8,800	Kelly et al. (1975)
" " " "	New Caledonia	leaf	D	6,000	Brooks et al. (1974)
Hybanthus caledonicus form B, small leaf	New Caledonia on peridotites		A	15,800	Kelly et al. (1975)
" " " "	" " "		D	1,700	"
Hybanthus caledonicus var. linearifolia	New Caledonia on serpentine		A	158,300	"
" " "	" " "		D	10,300	"
Hybanthus epacroides ssp. bilobus	W. Australia on sandstone	leaf	D	200.0	Severne (1972)
Hybanthus floribundus	W. Australia		A	130,000	Severne (1974)
" "	S. Australia on sandstone	leaf	D	60.0	Kelly et al. (1975)
" "	S. Australia on sandstone	"	D	1,100.0	"
" "	New Caledonia	flower	D	5,000	Jaffre & Schmid (1974)
" "	" "	seed	D	2,000	"
" "	New Caledonia on siltstone		A	140,000	Kelly et al. (1975)
" "	" " "		D	19,900	"
" "	W. Australia	leaf	D	6,542.0	Severne (1974)
" "	" "	photosynthetic stem	D	5,490.0	"
" "	" "	woody stem	D	3,806.0	"

Hybanthus floribundus	W. Australia	inner root	D	415.0	Severne (1974)
" "	" "	root bark	D	221.0	"
" "	" "	outer leaf tip	D	4,869.0	"
" "	" "	petiole half of leaf	D	4,023.0	"
" "	" "	hard inner wood	D	502.0	"
" "	" "	soft outer wood	D	1,269.0	"
" "	" "	trunk bark	D	1,653.0	"
" "	" "	seed capsule	D	1,500.0	"
" "	" "	seed	D	2,000.0	"
" "	" "	flower	D	5,003.0	"
Hybanthus floribundus ssp. adpressus	" "	leaf	D	1,300.0	Severne (1972)
Hybanthus floribundus ssp. curvifolius	" "	"	D	7,000	"
Hybanthus floribundus ssp. floribundus	" "	"	D	16,000	"
Rush Juncus articulatus	Scotland, serpentine	shoot	A	717.0	Shewry & Peterson (1976)
Juniper Juniperus osteosperma	Nevada, Pahute Mesa	leaf	D	70.0	Wallace & Romney (1972)
Cedar Juniperus virginianus	Missouri	twig & needle	D	(2.7-2.9)	Connor et al. (1970)

Krameria Krameria parvifolia	Nevada	leaf	D	(trace-1.7)	Wallace & Romney (1972)
" "	"	stem	D	(trace-3.4)	"
Lettuce Lactuca sativa	Australia, near Cu smelter		D	2.7±0.3	Beavington (1975)
" "	Toronto muck	leaf, spring	D	27.9	Hutchinson et al. (1974)
" "	"	leaf, fall	D	2.8	"
" "	"	root, spring	D	14.7	"
" "	"	root, fall	D	3.9	"
" "	United States	leaf	W	1.14	Schroeder et al. (1962)
" "	" "	head	W	0.14	"
" "			D	1.51	Bertrand & Mokragnatz (1930)
" "	Alabama	head		(2.2-3.9)	Giordano & Mays (1977)
" "	New Jersey	"		1.5	Painter et al. (1953)
Creosote bush Larrea divaricata	Nevada, grown in desert	leaf	D	(0.8-1.8)	Wallace & Romney (1972)
" "	Nevada, seasonal	"	D	(1.0-5.1)	"
" "	"	stem	D	(3.0-5.7)	"
Ledum palustre			Ni detector plant		NASA (1968)

Lentil *Lens culinaris*			D 1.61	Bertrand & Mokragnatz (1930)
Leptospermum scoparium	New Zealand	leaf	A (<20.0-2,550.0)	Lyon et al. (1971)
" "	" "		A 4,900.0	Lyon & Brooks (1970)
Linosyris villosa	Ural Mts.		Pale color used for prospecting for Ni-Co deposits	Malyuga (1964) in Cannon (1971)
Tulip poplar *Liriodendron tulipifera*	Tennessee		D (0.5-1.0)	Van Hook et al. (1974)
Tan oak *Lithocarpus densiflora*	serpentine area	3rd year growth	D 630.0 (max.)	Cannon (1969)
Perennial ryegrass *Lolium perenne*	New Zealand along highway	root	D 4.0	Ward et al. (1977)
" "	" " "	leaf	D 2.6	"
Alpine campion *Lychnis (Viscaria) alpina*	Finland		Used in economic prospecting for Ni	Cannon (1971)
Lycium *Lycium andersoni*	Nevada, in desert	leaf	D (2.0-4.3)	Wallace & Romney (1972)
Lycium pallidum	" "	leaf	D (1.2-2.4)	"
Lycium shockleyi	" "	"	D (0.5-0.9)	"
Tomato *Lycopersicon esculentum*	Ontario Sudbury Ni smelter area		Tomato seedlings grown in extracts of Ni from soil around smelter. Took up 54.6 to 1033.9 ppm Ni.	Hutchinson & Whitby (1973)

Tomato *Lycopersicon esculentum*			D	(0.01-0.154)	Vanselow (1966)
" "	United States	fruit	W	0.03	Schroeder et al. (1962)
" "	Alabama	"		(1.1-1.8)	Giordano & Mays (1977)
" "	"	"		(1.5-2.5)	"
Apple *Malus malus*	United States	fruit	W	(ND-0.08)	Schroeder et al. (1962)
" "	" "	bark	W	5.92	"
" "	" "	leaf	W	(0.76-3.01)	"
Alfalfa *Medicago sativa*			decreased yield D	44.0	Halstead et al. (1969)
" "	New Jersey	stem & leaf		(0.3-3.2)	Painter et al. (1953)
Banana *Musa sapientum*			W	0.34	Schroeder et al. (1962)
Forget-me-not *Myosotis monroi*	New Zealand	leaf	A	860.0 ± SD 0.2	Lyon et al. (1971)
" "	" "		A	8,000.0	Lyon & Brooks (1970)
Forget-me-not *Myosotis sp.*			A	(5500-6100)	Nat. Acad. Sci. (1975)
Bay *Myrica sp.*		leaf	W	0.88	Schroeder et al. (1962)
Nutmeg *Myristica fragrans*			W	1.17	"
Myristica laurifolia var. bifurcata	Indonesia, Molluccas	leaf	D	1,100	Wither & Brooks (1977)

Myrsine divaricata	New Zealand		A	2,000	Lyon & Brooks (1970)
Tobacco *Nicotiana tabacum*	W. Germany			Ni found, level in smoke may not be at carcinogenic level	Szadkowski et al. (1969)
Red beech *Nothofagus fusca*	New Zealand	leaf	A	163.0±SD 148.0, median 90.0	Timperley et al. (1970)
Silver beech *Nothofagus menziesii*	" "	"	A	193.0±SD 136.0, median 157.0	"
Notothlaspi australe	" "	"	A	640.0±SD 0.26	Lyon et al. (1971)
Water lily *Nuphar variegatum*	Ontario	leaf	W	(8.0-62.0)	Hutchinson et al. (1975)
" "	"	petiole	W	(5.0-35.0)	"
" "	"	peduncle	W	(3.0-9.0)	"
" "	"	root	W	(5.0-14.0)	"
Rice *Oryza sativa*	Japan	polished grain	W	(0.5-0.65)	Schroeder et al. (1962)
" "	"	unpolished grain	W	1.8	"
" "	United States	polished grain	W	0.47	"
" "		"	D	0.02	Vanselow (1966)
Grass *Oryzopsis hymenoides*	Nevada in desert	top	D	1.0	Wallace & Romney (1972)

Paspalum dilatatum	New Zealand along highway	root	D	0.7	Ward et al. (1977)
" "	" " "	leaf	D	1.3	"
Parsnip *Pastinica sativa*	Toronto muck soil	leaf	D	5.8	Hutchinson et al. (1974)
" "	" "	root	D	23.4	"
Princess tree *Paulownia tomentosa*	Tokyo industrial area	leaf		(7.0-15.0)	Maeno (1971)
Pearsonia metallifera	Rhodesia	leaf	A	153,000	Wild (1974)
" "	"	"	D	5,000	Brooks (1978)
Lima bean *Phaseolus limensis*	Alabama	bean		1.3	Giordano & Mays (1977)
" "	"	leaf		2.6	"
Kidney bean *Phaseolus vulgaris*	United States	bean	W	2.59	Schroeder et al. (1962)
Bean *Phaseolus sp.*	" "		W	(0.17-0.65)	"
Timothy *Phleum pratense*	New Jersey	stem & leaf		1.1	Painter et al. (1953)
Spruce *Picea abies*	Sweden industrial polluted area	root	D	(5.8-7.6)	Tyler (1972)
" "	"	wood	D	0.5	"
" "	"	bark	D	2.5	"
" "	"	twig, 1st year	D	14.0	"

Spruce *Picea abies*	Sweden industrial polluted area	twig, 2nd year	D	13.0	Tyler (1972)
" "	"	twig, 3rd year	D	13.0	"
" "	"	twig, 4th year	D	10.0	"
" "	"	twig, 5th-7th year	D	6.1	"
" "	"	needle 1st yr.	D	3.8	"
" "	"	needle 2nd yr.	D	3.4	"
" "	"	needle 3rd yr.	D	2.5	"
" "	"	needle 4th yr.	D	3.0	"
" "	"	needle 5th-7th year	D	3.2	"
" "	"	needle litter	D	26.0	"
" "	Connecticut	leaf	D	(5.0-8.0)7.0 ±SE 1.0	Smith (1973)
" "	"	twig	D	(5.0-9.0)7.0 ±SE 1.0	"
Pimelea suteri	New Zealand	leaf	A	5860.0±SD 0.23	Lyon et al. (1971)
" "	" "		A	5,500.0	Lyon & Brooks (1970)
" "	" "		A	25,000	Lyon et al. (1967)
Allspice *Pimenta officionalis*			W	0.79	Schroeder et al. (1962)

Knobcone pine *Pinus attenuata*	serpentine area	2nd yr. twig	D	300.0	Cannon (1969)
Jack pine *Pinus banksiana*	Ontario (June) dist. from Ni smelter (mi):				Hutchinson & Whitby (1974)
" "	" " 4.6	needle	D	(90.2-127.1)	"
" "	" " 6.5	"	D	(10.3-20.5)	"
" "	" " 12.0	"	D	(51.3-63.6)	"
" "	" " 18.0	"	D	(20.5-30.8)	"
" "	" " 31.0	"	D	(22.6-24.6)	"
	(August)				
" "	" " 4.6	"	D	(32.8-108.7)	"
" "	" " 6.5	"	D	(45.1-57.4)	"
" "	" " 8.4	"	D	30.8	"
" "	" " 12.0	"	D	(57.4-63.6)	"
" "	" " 18.0	"	D	(18.5-24.6)	"
" "	" " 31.0	"	D	(65.6-90.2)	"
Short leaf pine *Pinus echinata*	Tennessee		D	(1.0-20.0)	Van Hook et al. (1974)
Red pine *Pinus resinosa*	Ontario (June) dist. from Ni smelter (mi):				Hutchinson & Whitby (1974)
" "	" " 4.6	needles	D	(14.4-125.1)	"
" "	" " 6.5	"	D	8.2	"
" "	" " 12.0	"	D	(36.9-55.4)	"
" "	" " 18.0	"	D	(14.4-26.7)	"
" "	" " 31.0	"	D	(139.4)	"

Red pine *Pinus resinosa*	Ontario (August) dist. from Ni smelter (mi):				Hutchinson & Whitby (1974)
" "	" " 4.6	needles	D	(36.9-69.7)	"
" "	" " 6.5	"	D	(20.5)	"
" "	" " 18.0	"	D	(14.4-20.5)	"
" "	" " 31.0	"	D	(16.4-77.9)	"
Eastern white pine *Pinus strobus*	Ontario (June & August) dist. from Ni smelter (mi):				
" "	" " 6.5	"	D	(13.0-58.6)	"
" "	" " 8.4	"	D	(54.3-82.5)	"
" "	" " 18.0	"	D	(28.2-39.1)	"
" "	" " 31.0	"	D	(19.5-28.2)	"
Pea *Pisum sativum*	United States	seed, fresh	W	0.3	Schroeder et al. (1962)
" "	" "	seed, split, dry	W	1.66	"
" "			D	(2.0-2.25)	Vanselow (1966)
Planchonella oxyedra	Indonesia, Moluccas	leaf	D	19,600	Wither & Brooks (1977)
" "	S.E. Asia	"	D	(50.0-19,600) 1,600	"
" "			this hyperaccumulator is useful for biogeochemical prospecting		"
Plantain *Plantago maritima*	Scotland serpentine	shoot	A	588.0	Shewry & Peterson (1976)

Plantain *Plantago maritima*	Scotland, non-serpentine	shoot	A	21.0	Shewry & Peterson (1976)
" "	Austria chromite mine	"	A	(105.0-337.0)	"
Plantain *Plantago spp*.	New Zealand (along highway)	root	D	1.8	Ward et al. (1977)
" "	" " "	leaf	D	3.1	"
Blue grass *Poa annua*	" " "	root	D	2.5	"
" "	" " "	leaf	D	3.3	"
Kentucky blue grass *Poa pratensis*	New Jersey	stem & leaf		2.4	Painter et al. (1953)
Large-tooth aspen *Populus grandidentata*	Ontario dist. from Ni smelter (mi):				Hutchinson & Whitby (1974)
" "	" " 1.0	leaf	D	(77.9-235.2)	"
" "	" " 1.4	"	D	90.2	"
" "	" " 4.6	"	D	(94.3-123.0)	"
" "	" " 12.0	"	D	75.9	"
" "	" " 18.0	"	D	(43.1-45.1)	"
" "	" " 31.0	"	D	16.4	"
Poplar *Populus tremuloides*	" " 1.0	"	D	(54.5-231.5)	"
" "	" " 1.4	"	D	(124.9-152.1)	"
" "	" " 6.5	"	D	11.4	"
" "	" " 8.4	"	D	(72.6-118.0)	"
" "	" " 18.0	"	D	(27.2-59.0)	"
" "	" " 31.0	"	D	(20.4-34.1)	"

Potamogeton sp.	Ontario (smelter contam.)	leaf	W (39.0-690.0)	Hutchinson et al. (1975)
" "	"	stem	W (7.0-255.0)	"
Self head Prunella vulgaris	Scotland serpentine	shoot	A 831.0	Shewry & Peterson (1976)
Apricot Prunus armeniacum			D 0.64	Bertrand & Mokragnatz (1930)
Plum Prunus domestica			D 0.9	"
Psychotria douarrei	New Caledonia		A 140,000	Kelly et al. (1975)
" "	" "		D 19,900.0	"
" "	" "	leaf	D 47,000 (highest Ni content known)	Jaffre & Schmid (1974)
Bracken fern Pteridium aquilinum	Ontario dist. from Ni smelter (mi):			Hutchinson & Whitby (1974)
" "	" " 4.6	leaf	D 43.1	"
" "	" " 6.5	"	D 27.2	"
" "	" " 8.4	"	D 15.9	"
" "	" " 12.0	"	D 43.1	"
" "	" " 18.0	"	D (20.4-31.8)	"
" "	" " 31.0	"	D (13.6-20.4)	"
Pulsatella patens	Ural Mts.		On Ni-Co deposits, pale foliage and lack of petals	Malyuga (1964)
Pear Pyrus communis	United States	fruit	W 0.2	Schroeder et al. (1962)

Pear *Pyrus communis*		fruit	D	0.9	Bertrand & Mokragnatz (1930)
Pin oak *Quercus palustris*	Connecticut	leaf	D	(6.0-13.0)10.0 ±SE 0.6	Smith (1973)
" "	"	twig	D	(5.0-16.0)8.0 ±SE 1.0	"
Chestnut oak *Quercus prinus*	Tennessee		D	(1.0-4.0)	Van Hook et al. (1974)
Red oak *Quercus rubra*	Ontario dist. from Ni smelter (mi):				Hutchinson & Whitby (1974)
" "	" " 1.0	leaf	D	(79.0-108.0)	"
" "	" " 4.6	"	D	(73.8-77.9)	"
" "	" " 6.5	"	D	(12.3-57.4)	"
Quintinia acutifolia	New Zealand	"	A	92.0±SD 40.0 median 87.0	Timperley et al. (1970)
Raphanus sativus	Alabama	leaf		3.9	Giordano & Mays (1977)
" "	"	fruit		3.0	"
Sumach *Rhus sp.*	New England	berry	W	1.1	Schroeder et al. (1962)
Rinorea bengalensis	S. E. Asia on limestone	leaf	D	500.0	Brooks & Wither (1977)
" "	S.E. Asia & Oceania	"	D	17,500 (max.)	"
" "			Useful for bio-geochemical prospecting		"
Rinorea javanica		leaf	D	2,200	Brooks et al. (1977b)

Water cress *Rorippa nasturtium-aquaticum*		top	D	0.5	Vanselow (1966)
" " "		leaf	D	0.13	"
Rubus saxatilis	Scotland serpentine	shoot	A	978.0	Shewry & Peterson (1976)
Ruppia spiralis	Caspian Sea		D	0.82	Malyuga (1946)
Sugar cane *Saccharum officinarum*		sugar	W	0.03	Schroeder et al. (1962)
Sagina sp.	Scotland serpentine	shoot	A	(1236-2407)	Shewry & Peterson (1976)
Sève bleue (blue sap) *Sebertia acuminata*	New Caledonia	leaf	D	11,700	Jaffré et al. (1976)
" "	" "	latex	D	257,000	"
" "	" "	"	W	112,000	"
Rye *Secale cereale*	United States	grain	W	2.7	Schroeder et al. (1962)
" "		"	D	0.23	Nat. Acad. Sci. (1975)
" "	Wisconsin		D	(0.9-1.4)	Keeney & Walsh (1975)
Moss campion *Silene acaulis*	Scotland serpentine	shoot	A	1906.0	Shewry & Peterson (1976)
" "	Scotland non-serpentine	"	A	36.0	"
" "	Shetland Isl.	"	A	1781.0	"
Campion *Silene maritima*	Scotland serpentine	"	A	405.0	"

Campion Silene maritima	Scotland non-serpentine	shoot	A	25.0	Shewry & Peterson (1976)
" "	Austria chromite mine	"	A	108.0	"
" "	Shetland Isl.	"	A	328.0	"
Campion Silene otites	Austria serpentine	"	A	141.0	"
Campion Silene vulgaris	" "	"	A	83.0	"
Sitanion hystrix	Nevada	top	D	0.5	Wallace & Romney (1972)
Potato Solanum tuberosum	Toronto muck	leaf, spring	D	11.9	Hutchinson et al. (1974)
" "	"	leaf, fall	D	4.6	"
" "	"	tuber, spring	D	8.9	"
" "	"	tuber, fall	D	2.7	"
" "		tuber	D	(0.08-0.37)	Vanselow (1966)
" "	United States	"	W	0.56	Schroeder et al. (1962)
" "	New Jersey	"		0.2	Painter et al. (1953)
Sorghum-sudan Sorghum bicolor x S. sudanese	Wisconsin		D	(2.2-2.5)	Keeney & Walsh (1975)
Spartina alternifolia	N.W. Atlantic	leaf	D	5.3	Windom (1972)

Sphaeralcea ambigua	Nevada, desert	leaf	D	(4.8-5.8)	Wallace & Romney (1972)
Spinach *Spinacia oleracea*		leaf	D	2.4	Vanselow (1966)
" "	United States	"	W	0.35	Schroeder et al. (1962)
" "	World	44 varieties	D	4.2 (mean)	Karvanek & Bohmova (1966)
" "	Alabama	leaf		2.3	Giordano & Mays (1977)
" "	New Jersey	leaf		2.2	Painter et al. (1953)
Stanleya pinnata	Nevada	leaf	D	3.6	Wallace & Romney (1972)
Grass *Stipa capillata*	Russia		A	6,400.0 (accumulator plant)	Malyuga (1947)
Succisa pratensis	Scotland serpentine	shoot	A	513.0	Shewry & Peterson (1976)
Yew *Taxus sp.*	Connecticut	leaf	D	(5.0-19.0)10.0 ±SE 1.0	Smith (1973)
" "	"	twig	D	(4.0-13.0)9.0 ±SE 1.0	"
Turtle grass *Thalassia testudinum*	Puerto Rico		D	(4.0-35.0)17.0	Lowman et al. (1967)
" "	" "		W	(1.0-6.0)3.25	"
" "	" "		D	(29.0-36.0)31.0	"(1966)
" "	" "		W	(4.2-5.7)4.8	"

Cocoa *Theobroma cacao*		seed	W	6.0	Schroeder et al. (1962)
Thymus drucei	Scotland serpentine	shoot	A	(844.0-1362.0)	Shewry & Peterson (1976)
" "	Scotland non-serpentine	"	A	53.0	"
" "	Austria chromite mine	"	A	(400.0-560.0)	"
Thymus serpyllum	Austria serpentine	"	A	174.0	"
Spanish moss *Tillandsia usnoides*	S.E. United States	whole plant	A	(7.0-200.0) geom mean 39.0 geom. dev. ±1.74	Shacklette & Connor (1973)
Trichospermum kjellbergii	Indonesia, Moluccas	leaf	D	3,800	Wither & Brooks (1977)
Red clover *Trifolium pratense*	New Jersey	stem & leaf		(0.3-3.0)	Painter et al. (1953)
White clover *Trifolium repens*	New Zealand (along highway)	root	D	5.2	Ward et al. (1977)
" "	" " "	leaf	D	4.7	"
Wheat *Triticum aestivum*	United States	grain, hard	D	0.47±SD 0.08	Zook et al. (1970)
" "	" "	grain, soft	D	0.31±SD 0.08	"
" "	" "	durum	D	0.29±SD 0.14	"
" "	" "	winter	W	0.16	Schroeder et al. (1962)

Wheat _Triticum aestivum_	United States	flour	W	(0.3-0.54)	Schroeder et al. (1962)
" "	Vermont	crushed	W	0.75	"
" "		grain	D	(0.35-35.0)	Vanselow (1966)
Eastern hemlock _Tsuga canadensis_	Connecticut	leaf	D	(5.0-13.0)8.0 ±SE 1.0	Smith (1973)
" "	"	twig	D	(6.0-22.0)11.0 ±SE 2.0	"
Blueberry _Vaccinium augustifolium_	Ontario, Sudbury dist. from smelter (km):				Hutchinson & Whitby (1974)
" "	" " 1.7	leaf	D	92.3	"
" "	" " 2.1	"	D	55.4	"
" "	" " 7.4	"	D	45.1	"
" "	" " 10.4	"	D	10.3	"
" "	" " 13.4	"	D	37.0	"
" "	" " 20.4	"	D	36.4	"
" "	" " 39.0	"	D	16.4	"
" "	" " 52.7	"	D	14.4	"
Bilberry _Vaccinium myrtillus_	Sweden, in industrial contaminated spruce forest		D	4.8	Tyler (1972)
Cowberry _Vaccinium vitis-idaea_	" " " "		D	6.2	"
Vellozia equisetoides	Rhodesia		D	380.0	Wild (1970)
Vellozia sp.	Russia		A	270.0	Malyuga (1947)

Kamahi Weinmannia racemosa	New Zealand	leaf	A	126.0±SD 87.0 median 105.0	Timperley et al. (1970)
Yucca Yucca brevifolia	Nevada, grown	shoot	D	(4.1-5.8)	Wallace & Romney (1972)
" "	" 1-3 yr.old	leaf	D	(3.0-7.0)	"
" "	" 20 yr. old	"	D	52.0	"
Yucca Yucca schidigera	" grown	shoot	D	(2.0-4.0)	"
" "	"	irradiated shoot	D	(2.0-17.0)	"
Corn Zea mays	United States	frozen grain	W	0.7	Schroeder et al. (1962)
" "		grain	D	0.14	Vanselow (1966)
" "	Wisconsin	"	D	(0.8-1.1)	Keeney & Walsh (1975)
" "	"	stover	D	(0.5-1.0)	"
" "	Ohio	root	D	27.8	Kirkham (1975)
" "	"	stem	D	2.1	"
" "	"	leaf	D	2.0	"
" "	"	husk	D	1.0	"
" "	"	grain	D	1.0	"
" "	(summary, literature)	leaf	D	(0.1-5.0)	"
" "	"	grain	D	(0.1-5.0)	"
" "	New Jersey	leaf		(0.3-1.1)	Painter et al. (1953)

Eel grass Zostera marina	Black Sea	D 0.4	Malyuga (1946)
Eel grass Zostera nana	Caspian Sea	D 0.13	Malyuga (1946)
"Honey"	New York	W (0.011-0.83)	Tong et al. (1975)

NICKEL IN MOSSES, LICHENS AND FUNGI(1)

MOSSES

Species	Locality	Tissue	Analysis(2) PPM	Authority
Hylocomium splendens	S. central Sweden		D >6.0 to 8.0)	Ruhling & Tyler (1973)
" "	S.W. Sweden		D (4.0-6.0)	"
" "	S.E. Sweden		D (2.5-4.0)	"
" "	N.E. Finland		D 6.0	"
Leucobryum glaucum	S. New England near industry		4.5	Groet (1976)
" "	New England		0.3	"
Hypnum cupressiforme	Wales, Swansea dist. downwind from urban industrial complex (km): (Ni source is 3 km downwind)			Goodman & Roberts (1971)
" "	" " "	1.5	D dead	"
" "	" " "	3.0	D dead	"
" "	" " "	8.0	D 193.0	"
" "	" "	8.0	D 46.0	"
" "	" " "	25.0	D 25.0	"

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(1) Blank spaces indicate information not available or not applicable. ? indicates questionable data.

(2) W, D or A indicates on a Wet, Dry or Ashed basis. A single number indicates a single determination or mean. (x-y) indicates range of values, followed by the mean. ± Standard deviation (SD), standard error (SE), median, and geometric mean are indicated as reported. pCi/g = picocuries per gram.

Hypnum	*cupressiforme*	Wales, Swansea dist. downwind from urban industrial complex (km): (Ni source is 3 km downwind)					Goodman & Roberts (1971)
"	"	" " "	25.0		D	12.0	"
"	"	upwind	18.0		D	10.0	"
"	"	S. Sweden control			D	5.5	"
"	"	Transplanted & suspended					
		exposure/ wks.	distance/ km.				
"	"	---	15	upwind	D	16.0	"
"	"	2	14	"	D	20.0	"
"	"	2	1	downwind	D	18.0	"
"	"	8	1	"	D	25.0	"
"	"	2	2	"	D	19.5	"
"	"	8	4	"	D	215.0	"
"	"	2	6	"	D	900.0	"
"	"	---	7	"	D	107.0	"
"	"	8	7	"	D	69.0	"
"	"	2	8	"	D	152.0	"
"	"	Wales			D	(10.0-25.0) 17.0±SE 1.1	Roberts & Goodman (1973)
"	"	S. Sweden Skåne			D	6.7-13.3	Ruhling & Tyler (1969)
"	"	Sweden, 1870-1899			D	4.0 (means)	"
"	"	Sweden 1900-1919			D	3.7 "	"

Hypnum cupressiforme	Sweden 1920-1943		D	5.5 (means)	Ruhling & Tyler (1969)
" "	Sweden, 1969		D	9.1 "	"
" "				Increase of Ni is correlated with increased world use of Ni between 1920 and 1969.	"
" "	Sweden, Norrkoping (polluted by industry)		D	36.0	Tyler (1969)
" "	C. Sweden, in spruce forest contaminated by industry		D	52.0	Tyler (1972)
Sphagnum angustifolium	S. Finland		D	1.6	Pakarinen & Tolonem (1976)
" "	NWT, Great Slave Lake		D	0.3	"
Sphagnum balticum	S. Finland		D	1.2	"
Sphagnum fuscum	Finland		D	(0.55-2.2)1.2	"
" "	S. Finland		D	2.1	"
" "	NWT, Great Slave Lake		D	(0.24-0.33)	"
" "	Alberta, Edmonton		D	0.8	"
Sphagnum magellanicum	S. Finland		D	1.8	"
" "	S. Sweden		D	(2.5-4.9)	Ruhling & Tyler (1970)
Sphagnum Sphagnum spp.	United States	peat	W	0.62	Schroeder et al. (1962)

NICKEL IN MOSSES, LICHENS AND FUNGI

LICHENS

Alectoria (2 spp.)	N.W.T. Arctic	D	1.0±SD 1.0	Nieboer et al. (1975)
Campylium polyganum	Finland on serpentine	D	420.0	Lounamaa (1956)
Cetraria (5 spp.)	N.W.T. Arctic	D	1.0±SD 1.0	Nieboer et al. (1975)
Cladina alpestris	Ontario, Sudbury Ni smelter	D	11.0±SD 1.0	"
" "	Finland on nickeliferous rocks	D	200.0	Lounamaa (1956)
Cladina mitis	Ontario, Sudbury Ni smelter	D	10.0±SD 1.0	Nieboer et al. (1975)
Cladina sylvatica	Finland on nickeliferous rocks	D	200.0	Lounamaa (1956)
Cladina (3 spp.)	N.W.T. Arctic	D	1.0±SD 1.0	Nieboer et al. (1975)
Cladonia deformis	Ontario, Sudbury Ni smelter	D	10.0±SD 1.0	"
Cladonia sp.	Ontario	Ni content higher near smelter		"
Cladonia (5 spp.)	N.W.T. Arctic	D	1.0±SD 1.0	"
Cladonia uncialis	Ontario, Sudbury Ni smelter	D	10.0±SD 1.0	"
Dactylina arctica	N.W.T. Arctic	D	1.0±SD 1.0	"
Lecanora rubina	Colorado, on sandstone	A	15.0	Ferry et al. (1973)

Nephroma arcticum	Canada Arctic		D	(2.0-5.0)	Nieboer et al. (1975)
Parmelia centrifuga	Finland, on serpentine		A	600.0	Ferry et al. (1973)
Parmelia conspersa	Colorado, on sandstone		A	(15.0-20.0)	"
Parmelia physodes	Sweden, in spruce forest polluted by industry		D	18.0	Tyler (1972)
Peltigera aphthosa	Canada, Arctic		D	(2.0-12.0)	Nieboer et al. (1975)
Peltigera polydactyla	"		D	(2.0-12.0)	"
Peltigera rufescens	Great Britain dist. downwind from steel smelter (meters):				Seaward (1973) in Ferry et al. (1973)
" "	" "	0	D	38.46	"
" "	" "	100	D	24.1	"
" "	" "	270	D	33.35	"
" "	" "	440	D	10.85	"
" "	" "	610	D	52.38	"
" "	" "	780	D	26.15	"
" "	control		D	10.33	"
Peltigera (2 spp.)	N.W.T. Arctic		D	$1.0 \pm$ SD 1.0	Nieboer et al. (1975)
Ramalina fastigiata				$NiCl_2$ depressed respiration to 46% in 4 hours	Ferry et al. (1973)
Stereocaulon sp.	Ontario, Sudbury			Selective in uptake, and is related to Ni level near smelter.	"

Stereocaulon paschale	Ontario, Sudbury dist. from Ni smelter (mi.):				Nieboer et al. (1975)
" "	" "	5	D	30.5	"
" "	" "	8	D	180	"
" "	" "	15	D	100	"
" "	" "	30	D	40	"
" "	" "	60	D	26.0±SD 1.0	"
Stereocaulon tomentosum	N.W.T. Arctic		D	1.0±SD 1.0	"
Thamnolia vermicularis	" "		D	1.0-3.0	"
Umbilicaria deusta	Ontario, Sudbury dist. from Ni smelter (mi):				
" "	" "	10	D	220	"
" "	" "	15	D	150	"
" "	" "	30	D	55	"
" "	" "	60	D	37.0±SD 1.0	"
Umbilicaria hyperborea	Colorado, on sandstone		A	(50.0-100.0)	Leroy & Koksoy (1962)
Umbilicaria muhlenbergii	Ontario, Sudbury		D	16.0±SD 1.0	Nieboer et al. (1975)
Usnea fragilescens				$NiCl_2$ depressed respiration to 43% in 4 hrs.	Ferry et al. (1973)
Xanthoria (*Caloplaca*) *elegans*	Colorado, on sandstone		A	30.0	Leroy & Koksoy (1962)
Lichens	Ontario, Sudbury		D	(8.0-312.0)	Nieboer et al. (1975)
Lichens	Canada, Arctic		D	(1.0-12.0)	"

NICKEL IN MOSSES, LICHENS AND FUNGI

FUNGI

Gem-studded puffball _Lycoperdon perlatum_	Connecticut	sporophores, unwashed	D	2.37	McCreight & Schroeder (1977)
" "	"	sporophores, washed with detergent	D	0.0	"
"Mushroom"			D	3.5	Vanselow (1966)

NICKEL IN ALGAE(1)

Species	Locality	Tissue	Analysis(2) PPM	Authority
Brown alga Agarum cribosum	Sea of Japan		D (20.2-25.4)	Gryzhankova et al. (1973)
" "	" " "		D 1.35	Saenko et al. (1976)
Alaria esculenta	Russia		A 1.6	Malyuga (1946)
" "	"		D 0.42	"
" "	"		W 0.073	"
Amphirea fragilissima	Puerto Rico		W 12.26	Stevenson et al. (1966)
Brown alga, knotted wrack Ascophyllum nodosum	Scotland		D (1.5-4.4)3.2	Black & Mitchell (1952)
" "	"		W 0.92	"
" "	Nova Scotia		D 0.57	Young & Langille (1958)

(1) Blank spaces indicate information not available or not applicable. ? indicates questionable data.

(2) W, D or A indicates on a Wet, Dry or Ashed basis. A single number indicates a single determination or mean. (x-y) indicates range of values, followed by the mean. ± Standard deviation (SD), standard error (SE), median, and geometric mean are indicated as reported. pCi/g = picocuries per gram.

Brown alga, knotted wrack Ascophyllum nodosum	Great Britain Dulas Bay	D	(3.9-5.2)4.6	Foster (1976)
" "	Great Britain Menai Straits	D	(4.5-6.3)	"
" "	Russia	A	2.1	Malyuga (1946)
" "	"	D	0.43	"
" "	"	W	0.13	"
" "	Norway	D	(1.0-22.0)	Lande (1977)
Red alga Bryothamnion triquetum	Puerto Rico	W	4.83	Stevenson et al. (1966)
Green alga Caulerpe okamurai	Japan	D	5.64	Ishibashi et al. (1964)
Green alga Caulerpe racemosa	Texas	D	(5.0-6.5) 5.81	Harriss (1965)
Ceratodictyon spongiosum	Japan	D	5.04	Ishibashi et al. (1964)
Green alga Chaetomorpha crassa	Japan	D	0.75	"
Green alga Chaetomorpha spiralis	Japan	D	1.66	"
Green alga Chlorella fusca	Ontario	Grew in lakes with 3.0 ppm Ni		Stokes et al. (1973)
Red alga Chondrus crispus	Nova Scotia	D	>2.0	Young & Langille (1958)

Red alga Chondrus yendoi	Sea of Japan		D	0.16	Saenko et al. (1976)
Brown alga Chorda filum	Sea of Japan		D	(9.9-12.2)	Gryzhankova et al. (1973)
" "	" " "		D	0.19	Saenko et al. (1976)
Brown alga Chordaria maggelanica	" " "		D	23.1±1.7	Gryzhankova et al. (1973)
Green alga Cladophora fascicularis	Puerto Rico		W	1.0	Stevenson et al. (1966)
Green alga Cladophora glomerata	Sweden (polluted area)		D	(30.0-48.0)	Hagerhall (1972)
Green alga Cladophora sp.	Wales	bloom	W	(30.0-100.0)	Trollope & Evans (1976)
Brown alga Coccophora langsdorfii	Sea of Japan		D	14.8±0.0	Gryzhankova et al. (1973)
Green alga Coccomyxa sp.	Wales	bloom	W	150.0	Trollope & Evans (1976)
Green alga Codium isthmocladium	Puerto Rico		W	19.77	Stevenson et al. (1966)
Green alga Codium sp.	Sea of Japan		D	(14.7-16.8)	Gryzhankova et al. (1973)
Green alga Codium yessoensis	" " "		D	0.11	Saenko et al. (1976)

Brown alga *Costaria costata*	Sea of Japan	D	0.45	Saenko et al. (1976)
Cymodocea sp.	Puerto Rico	W	(1.5-2.6)2.1	Stevenson et al. (1966)
" "	" "	D	(19.0-29.0) 24.0	"
Cystophyllum sisymbricides	Japan	D	1.04	Ishibashi et al. (1964)
Desmarestia viridis	"	D	3.0	"
Brown alga *Dictyopteris justii*	"	W	3.93	"
Brown alga *Dictyota dichotoma*	Sea of Japan	D	8.1±0.6	Gryzhankova et al. (1973)
Brown alga *Dictyota divaricata*	Japan	W	9.71	Ishibashi et al. (1964)
Brown alga *Eisenia bicyclis*	"	D	(0.44-1.7)0.87	"
Green alga *Enteromorpha compressa*	"	D	6.41	"
Green alga *Enteromorpha intestinalis*	Sweden (polluted area)	D	(10.0-50.0)	Hagerhall (1972)
Green alga *Enteromorpha prolifera*	Sea of Japan	D	0.24	Saenko et al. (1976)
Green alga *Enteromorpha sp.*	" " "	D	(25.7-30.9)	Gryzhankova et al. (1973)
Brown alga *Fucus distichus*	W. Greenland	W	(0.6-2.3)	Bollingberg (1975)

Brown alga *Fucus inflatus*	Russia	A	34.0	Malyuga (1946)
" "	"	D	6.5	"
" "	"	W	1.5	"
Brown alga *Fucus serratus*	Scotland	D	(1.6-4.5)3.1	Black & Mitchell (1952)
" "	"	W	0.87	"
" "	Russia	A	13.0	Malyuga (1946)
" "	"	D	3.1	"
" "	"	W	0.71	"
Brown alga *Fucus spiralis*	Scotland	D	(6.0-9.3)7.7	Black & Mitchell (1952)
" "	"	W	1.7	"
Brown alga Bladder wrack *Fucus vesiculosus*	"	D	(3.8-5.9)4.9	"
" "	"	W	1.36	"
" "	Nova Scotia	D	2.0	Young & Langille (1958)
" "	Great Britain	D	(1.2-22.2)	Preston et al. (1972)
" "	W. Greenland	W	(0.6-2.3)	Bollingberg (1975)
" "	Great Britain	D	(10.5-29.6) 21.8	Fuge & James (1974)
" "	" "	D	(4.6-8.9)	Foster (1976)

Brown alga, bladder wrack *Fucus vesiculosus*	Norway		D	(2.0-7.0)	Lande (1977)
" "	Great Britain		D	(8.0-28.0)	Bradfield et al. (1976)
Brown alga *Heterochordaria abietina*	Sea of Japan		D	0.31	Saenko et al. (1976)
Hizikia fusiforme	Japan		D	(2.4-5.7) 4.05	Ishibashi et al. (1964)
Ishige okamurai	"		D	(0.74-4.97)2.85	"
Brown alga *Laminaria cichorioides*	Sea of Japan		D	0.25	Saenko et al. (1976)
Brown alga *Laminaria cloustoni*	Scotland	frond, sterile	D	2.0	Black & Mitchell (1952)
" "	"	frond, sporing	D	1.5	"
" "	"	frond	D	(0.9-1.6)1.3	"
Brown alga *Laminaria digitata*	"	frond	D	(1.4-8.2)3.16	"
" "	"	stipe	D	(3.7-5.7)4.43	"
" "	"	frond	W	(0.25-0.36)0.3	"
" "	"	stipe	W	(0.47-0.64)0.5	"
" "	Nova Scotia		D	0.30	Young & Langille (1958)
" "	Russia		A	2.9	Malyuga (1946)
" "	"		D	0.83	"
" "	"		W	0.099	"

Brown alga *Laminaria japonica*	Sea of Japan		D	0.43	Saenko et al. (1976)
Brown alga *Laminaria longicruris*	Nova Scotia		D	0.86	Young & Langille (1958)
Brown alga *Laminaria saccharina*	Russia		A	4.3	Malyuga (1946)
" "	"		D	1.7	"
" "	"		W	0.22	"
Brown alga *Macrocystis pyrifera*			D	<3.0	Vinogradov (1953)
Green alga *Microspora sp.*	Wales	bloom	W	100.0	Trollope & Evans (1976)
Green alga *Monostroma nitidum*	Japan		D	1.43	Ishibashi et al. (1964)
Green alga *Mougeotia sp.*	Wales	bloom	W	240.0	Trollope & Evans (1976)
Green alga *Oedogonium sp.*	"	"	W	70.0	"
Blue-green alga *Oscillatoria sp.*	"	"	W	1,070.0	"
Brown alga *Padina gymnospora*	Puerto Rico		D	(23.0-32.0) 27.0 ± 3.0	Stevenson & Ufret (1966)
Brown alga *Padina sp.*	" "		W	(5.0-9.0) 6.75	Lowman et al. (1967)
" "	" "		D	(40.0-55.0) 49.25	"

Brown alga *Pelvetia canaliculata*	Scotland	D	(1.9-4.8)3.5	Black & Mitchell (1952)
" "	"	W	1.1	"
" "	Norway	D	1.0	Lande (1977)
Brown alga *Pelvetia wrightii*	Sea of Japan	D	15.2±0.5	Gryzhankova et al. (1973)
" "	" " "	D	0.21	Saenko et al. (1976)
Green alga *Penicillus capitatus*	Puerto Rico	W	8.99	Stevenson et al. (1966)
Phyllaria sp.	Russia	A	1.1	Malyuga (1946)
" "	"	D	0.33	"
" "	"	W	0.038	"
Red alga *Polysiphonia urceolata*	Japan	D	3.68	Ishibashi et al. (1964)
Laverweed *Porphyra umbilicalis*	Great Britain	D	(0.2-9.7)	Preston et al. (1972)
" "	Russia	A	18.0	Malyuga (1946)
" "	"	D	2.6	"
" "	"	W	0.17	"
Red alga *Ptilota filicina*	Sea of Japan	D	0.87	Saenko et al. (1976)
Red alga *Rhodomela larix*	" " "	D	2.65	"

Red alga Rhodymenia palmata	Nova Scotia		D	>2.0	Young & Langille (1958)
Sargassum weed Sargassum giganteifolium	Japan		D	(0.36-0.72) 0.54	Ishibashi et al. (1964)
Sargassum weed Sargassum miyabei	Sea of Japan		D	8.4±0.6	Gryzhankova et al. (1973)
Sargassum weed Sargassum pallidum	" " "	leaf blade	D	7.7±0.3	"
" "	" " "	swim bladder	D	26.9±0.4	"
" "	" " "	stem	D	16.0±1.0	"
Sargassum weed Sargassum tenuifolium	Japan		D	5.54	Ishibashi et al. (1964)
Sargassum weed Sargassum thunbergii	"		D	(2.74-7.92)5.01	"
Sargassum weed Sargassum tortile	"		D	(0.59-1.08)0.84	"
Sargassum weed Sargassum sp.	Puerto Rico		D	30.0	Lowman et al. (1967)
" "	" "		W	5.0	"
" "	" "		D	(5.3-7.9) 5.82	Forster et al. (1972)
" "	Texas		D	(2.2-9.9)5.2	Horowitz & Presley (1977)
Green alga Scenedesmus acutiformis	Ontario, Sudbury		grew in lakes with 3.2 ppm Ni		Stokes et al. (1973)

Green alga Spirogyra sp.	Wales	bloom	W	(30.0-130.0)	Trollope & Evans (1976)
Spyridia filamentosa	Puerto Rico		D	17.0	Lowman et al. (1965)
" "	" "		W	1.7	"
Red alga Tichocarpus crinitus	Sea of Japan		D	8.8±0.6	Gryzhankova et al. (1973)
Xanthophyta Tribonema sp.	Wales	bloom	W	(160.0-290.0)	Trollope & Evans (1976)
Brown alga Turbinaria turbinata	Puerto Rico		A	72.0	Lowman et al. (1966)
Green alga Udotea flabellum	" "		W	(13.0-140.0) 40.0	"
" "	" "		D	(25.0-150.0) 47.0	"
Green alga Ulothrix sp.	Wales		W	300.0	Trollope & Evans (1976)
Green alga Ulva conglobata	Japan		D	1.57	Ishibashi et al. (1964)
Green alga Ulva fenestrata	Sea of Japan		D	4.9±0.4	Gryzhankova et al. (1973)
" "	" " "		D	0.93	Saenko et al. (1976)
Green alga Ulva lactuca	Nova Scotia		D	> 2.0	Young & Langille (1958)

Green alga *Ulva lactuca*	Russia	A	4.1	Malyuga (1946)
" "	"	D	0.72	"
" "	"	W	0.16	"
" "	Great Britain	D	(8.0-33.0)	Boyden (1975)
Green alga *Ulvaria splendens*	Sea of Japan	D	3.27	Saenko et al. (1976)

SELENIUM IN MAMMALS (1)

Species	Locality	Tissue	Analysis (2) PPM	Authority
Pronghorn antelope *Antilocapra americana*	Idaho	hair	(0.08-17.0)	Huckabee et al. (1972)
" "	Wyoming	"	(2.6-9.3)	"
" "	"	" (pregnant doe)	4.5	"
" "	"	" (pre-term fetus)	4.8	"
Whale *Balaenoptera physalus*		muscle	W 0.5	Lunde (1970)
" "		water soluble muscle	W 0.4	"
Cow *Bos bovis*		(Alkali disease)	(5.0-50.0)	Radeleff (1964)
" "	Ontario	(white muscle disease, Se deficiency) hair	(0.06-0.23)	Hidiroglau et al. (1965)
" "	"	(no white muscle disease) hair	0.25	"

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(2) W, D or A indicates on a Wet, Dry or Ashed basis. A single number indicates a single determination or mean. (x-y) indicates range of values, followed by the mean. ± Standard deviation (SD), standard error (SE), median, and geometric mean are indicated as reported. pCi/g = picocuries per gram.

Cow Bos bovis	Sweden	blood		(0.004-0.005)	Lindberg & Lannek (1970)
" "	"	milk		(0.0017-0.0049)	"
" "	United States	muscle	W	(0.28-0.42)	Schroeder et al. (1970)
" "	"	liver	W	0.18	"
" "	"	kidney	W	1.70	"
" "	"	milk	W	0.48	"
" "	Italy	"	W	(<0.004-0.02) 0.008	Rossi et al. (1976)
" "	"	cheese	W	0.02	"
" "	East Asia	milk	W	0.012	Leung (1973)
Dog Canis familiaris	Sweden	blood		0.3265± 0.0557	Lindberg & Lannek (1970)
Coyote Canis latrans	Wyoming	hair		(0.8-13.0)	Huckabee et al. (1972)
Guinea pig Cavia porcellus	United States (fed on swiss chard grown on sludge-amended soil)	liver	D	(0.82-1.12) 0.95	Furr et al. (1976)
" "	"	kidney	D	(1.59-1.69) 1.63	"
" "	"	muscle	D	(0.31-0.38) 0.35	"
" "	"	adrenal	D	(2.5-5.8)3.7	"
" "	"	spleen	D	(0.3-3.1)1.9	"

Elk *Cervus canadensis*	Idaho	hair		(0.8-2.0)1.2	Huckabee et al. (1972)
Red backed vole *Clethrionymys gapperi*	Wyoming	"		(0.1-0.9)0.5	"
Porcupine *Erethizon dorsatum*	New England	heart	W	0.45	Schroeder et al. (1970)
" "	"	lung	W	0.27	"
" "	"	liver	W	0.43	"
" "	"	spleen	W	0.45	"
" "	Wyoming	hair		1.0	Huckabee et al. (1972)
" "	"	quill		0.6	"
Chipmunk *Eutamias sp.*	"	hair		3.4	"
Cynomolgus monkey *Macaca fascicularis*	Canada (fed 10 ppm Na_2SeO_3)	" 40 days		2.35±0.45	Loew et al. (1975)
" "	" "	" 90 "		1.56±0.25	"
Vole *Microtus longicaudus*	Idaho	"		0.4	Huckabee et al. (1972)
Mountain vole *Microtus montanus*	Wyoming	"		(1.2-1.6)1.4	"
Meadow vole *Microtus pennsylvanicus*	"	"		(0.2-27.0)5.4	"
Richardsons vole *Microtus richardsoni*	"	"		1.2	"
Jack rabbit *Lepus americana*	New England	heart	W	1.97	Schroeder et al. (1970)
" "	"	lung	W	1.68	"
" "	"	liver	W	5.85	"

Jack rabbit __Lepus__ __americana__	New England	kidney	W	9.93	Schroeder et al. (1970)
" "	"	spleen	W	1.66	"
Woodchuck __Marmota__ __monax__	"	heart	W	0.20	"
" "	"	liver	W	0.35	"
" "	"	kidney	W	0.97	"
" "	"	spleen	W	0.67	"
Mouse __Mus__ __musculus__	" (females fed 3 ppm Se)				Schroeder & Mitchener (1972)
" "	" (controls)	heart	W	(0.13-0.37)0.24	"
" "	" "	lung	W	(0.28-0.53)0.39	"
" "	" "	liver	W	(0.37-0.69)0.54	"
" "	" "	kidney	W	(0.93-1.47)1.19	"
" "	" "	spleen	W	(0.3-0.95)0.8	"
" "	" (selenite fed)	heart	W	(0.59-1.83)1.20	"
" "	" "	lung	W	(0.95-1.68)1.24	"
" "	" "	liver	W	(1.52-2.39)2.58	"
" "	" "	kidney	W	(1.23-2.99)1.92	"
" "	" "	spleen	W	(0.97-9.26)4.64	"
" "	" (controls)	heart	W	(0.09-0.32)0.19	"
" "	" "	lung	W	(0.06-0.16)0.14	"
" "	" "	liver	W	(0.14-0.31)0.22	"
" "	" "	kidney	W	(0.4-0.68)0.56	"
" "	" "	spleen	W	(0.06-0.31)0.19	"
" "	" (selenate fed)	heart	W	(0.07-1.62)0.46	"

Mouse *Mus musculus*	New England (females fed 3 ppm Se)				Schroeder & Mitchener (1972)
" "	" (selenate fed)	lung	W	(0.14-0.73)0.37	"
" "	" "	liver	W	(0.18-1.26)0.76	"
" "	" "	kidney	W	(0.4-1.86)0.88	"
" "	" "	spleen	W	(0.17-1.26)0.56	"
" "	Liver and kidney accumulated Se as selenate				"
" "	Liver, kidney & spleen accumulated selenite				"
Pack rat *Neotoma cinerea*	Utah	kidney	D	(11.6-34.2)	Sharma & Shupe (1977)
Mule deer *Odocoilus hemonius*	Idaho	hair		(0.5-16.0) 5.05	Huckabee et al. (1972)
White-tail deer *Odocoilus virginianus*	New England	heart	W	0.23	Schroeder et al. (1970)
" "	"	kidney	W	1.92	"
Sheep *Ovis aries*	Canada	liver, mother	W	0.14	Hidiroglou et al. (1970)
" "	"	" foetus	W	0.119	"
" "	"	muscle mother	W	0.041	"
" "	"	" foetus	W	0.027	"
" "	"	heart mother	W	0.055	"
" "	"	" foetus	W	0.052	"
" "	"	lung mother	W	0.095	"
" "	"	" foetus	W	0.076	"

Sheep *Ovis aries*	Canada	kidney mother	W	0.48	Hidiroglou et al. (1970)
" "	"	" foetus	W	0.171	"
" "	"	spleen mother	W	0.164	"
" "	"	" foetus	W	0.146	"
" "	"	adrenal mother	W	0.218	"
" "	"	" foetus	W	0.183	"
" "	"	placenta mother	W	0.67	"
" "	East Asia	muscle	W	0.178	Leung (1973)
" "	United States	"	W	0.30	Schroeder et al. (1970)
Bighorn sheep *Ovis canadensis*	Wyoming	hair		3.1	Huckabee et al. (1972)
Harbor seal *Phoca vitulina*	Netherlands	liver	W	(46.0-134.0)	Koeman et al. (1973)
" "	"	"	W	57.2	"
Racoon *Procyon lotor*	New England	heart	W	(0.15-1.22)	Schroeder et al. (1970)
" "	"	lung	W	(0.13-1.28)	"
" "	"	liver	W	(0.51-2.57)	"
" "	"	kidney	W	(0.44-5.09)	"
" "	"	spleen	W	(0.23-1.38)	"
Rat *Rattus rattus*	"	hair	W	0.60	"
Gray squirrel *Sciurus carolinensis*	"	heart	W	(0.23-0.34)	"
" "	"	lung	W	(0.24-0.25)	"
" "	"	liver	W	(0.38-0.49)	"

Gray squirrel *Sciurus carolinensis*	New England	kidney	W	(0.97-2.05)	Schroeder et al. (1970)
" "	"	spleen	W	(0.32-0.33)	"
Shrew *Sorex vagrans*	Wyoming	hair		(2.1-68.0) 12.09	Huckabee et al. (1972)
Rock squirrel *Spermophilus variegatus*	Utah	kidney	D	(8.9-34.2)	Sharma & Shupe (1977)
" "	"	"	D	90.0 (max.)	"
Pig *Sus scrofa*	United States	hair		(<1.0-1.2)	Fuller et al. (1967)
" "	East Asia	muscle	W	0.239	Leung (1973)
" "	Italy	"	W	0.03	Rossi et al. (1976)
" "	United States	liver		(<1.0-5.3)	Fuller et al. (1967)
" "	"	kidney		(6.0-10.5)	"
" "	"	pancreas		(1.4-2.5)	"
" "	"	muscle		(<0.8-1.2)	"
" "	"	liver	W	0.64	Schroeder et al. (1970)
" "	"	kidney	W	4.17	"
" "	"	fat	W	0.42	"
" "	"	intestine		(1.1-1.7)	Fuller et al. (1967)
" "	"	thyroid		(<1.0-2.9)	"
" "	"	RBC		(<1.0-3.1)	"
" "	"	plasma		(<1.0-1.8)	"
" "	"	hair		(<1.0-1.2)	"
" "	"	bone		<1.0	"

Pig *Sus scrofa*	United States	teeth		<0.1	Fuller et al. (1967)
Fox *Vulpes fulva*	New England	heart	W	1.35	Schroeder et al. (1970)
" "	"	lung	W	1.54	"
" "	"	liver	W	2.29	"
" "	"	kidney	W	2.23	"
" "	"	spleen	W	1.65	"
California sea lion *Zalophus californianus*	California	liver mother	D	(28.0-352.0)	Martin et al. (1976)
" "	"	" kidney	D	(8.4-33.8)	"
" "	"	liver pup	D	(1.9-6.0)	"
" "	"	" kidney	D	(2.2-8.4)	"
Western jumping mouse *Zapus princeps*	Wyoming	hair		0.0	Huckabee et al. (1972)
" "	Idaho (mineralized area)	"		(1.6-2.4)	"
"Bat"	New England	heart	W	2.86	Schroeder et al. (1970)
"	"	lung	W	0.77	"
"	"	liver	W	(1.07-3.34)	"
"	"	kidney	W	1.17	"
"	"	skin & fur	W	4.0	"
"	"	muscle	W	0.49	"

"Wild rat"	New England	heart	W	0.23	Schroeder et al. (1970)
"	"	lung	W	0.32	"
"	"	liver	W	0.43	"
"	"	kidney	W	0.76	"
"	"	spleen	W	0.18	"

SELENIUM IN BIRDS (1)

Species	Locality	Tissue	Analysis (2) PPM		Authority
Razorbill *Alca torda*	Netherlands	liver	W	3.6	Koeman et al. (1975)
" "	"	brain	W	0.69	"
Mallard *Anas platyrhynchos*	Canada	feather	D	<0.05	Kelsall (1970)
Black duck *Anas rubripes*	"	"	D	<0.05	"
White-fronted goose *Anser albifrons*	"	"	D	<0.05	"
Lesser scaup *Aythya affinis*	"	"	D	<0.05	"
Chicken *Gallus domesticus*	Italy	muscle	W	(0.06-0.2) 0.15	Rossi et al. (1976)
" "	"	egg	W	(0.01-0.08) 0.04	"
" "	East Asia	" white	W	0.183	Leung (1973)
" "	"	" yolk	W	0.068	"

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Chicken *Gallus domesticus*	Italy	kidney	W	0.21±SD 0.02	Bombace et al. (1974)
" "	"	liver	W	0.21±SD 0.03	"
" "	"	feather	W	0.10±SD 0.07	"
" "	"	skin	W	0.08±SD 0.01	"
" "	"	egg white	W	0.036±SD 0.001	"
" "	"	" yolk	W	0.068±SD 0.003	"
" "	"	" shell	W	0.020±SD 0.007	"
Brown pelican *Pelecanus occidentalis*	South Carolina & Florida	egg	W	(0.19-0.38)	Blus et al. (1977)
" "	" & Georgia	liver	W	(1.01-4.42)	"
Guillemot *Uria aalge*	Netherlands	liver	W	(2.4-4.6)	Koeman et al. (1975)
" "	"	brain	W	(0.46-1.1)	"

SELENIUM IN AMPHIBIA(1)

Species	Locality	Tissue	Analysis PPM (2)		Authority
Toad *Bufo bufo*	Yugoslavia	liver	W	(0.69-0.77)	Byrne et al. (1975)
" "	" (Idrija mercury mine)	"	W	3.2	"
Frog *Rana temporaria*	" "	"	W	4.7	"

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SELENIUM IN MARINE FISH (1)

Species	Locality	Tissue	Analysis (2) PPM	Authority
Herring Clupea harengus	Sweden	muscle	W 1.0	Lunde (1970)
" "	"	" soluble	W 2.4	"
" "	"	bone	W 0.8	"
" "	"	skin	W 0.8	"
Cod Gadus morhua	"	muscle	W 1.2	"
" "	"	" soluble	W 2.6	"
" "	"	bone	W 0.7	"
" "	"	" soluble	W 1.6	"
" "	"	liver	W 3.7	"
" "	"	" soluble	W 4.6	"
" "	"	skin	W 8.6	"
" "	"	"soluble	W 1.4	"
" "	Atlantic	muscle	W (0.12-0.75)	Schroeder et al. (1970)

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Cod *Gadus spp.*	East Asia	muscle	W	0.427	Leung (1973)
Flatfish *Limanda herzensteini*	"	"	W	0.337	"
Black marlin *Makaira indica*	N.E. Australia	"	W	(0.4-4.3) 2.2±SE 0.154	Mackay et al. (1975)
" "	"	liver	W	(1.4-13.5) 5.4±SE 0.850	"
Dover sole *Microstomus pacificus*	S. California	"	W	(0.65-1.2)	DeGoeij et al. (1974)
Sardine *Sardinops melanostica*	East Asia		W	0.009	Leung (1973)
Mackerel *Scomber scombrus*	Sweden	mature muscle	W	1.3	Lunde (1970)
" "	"	immature muscle	W	1.4	"
" "	"	water soluble muscle	W	3.9	"
Norway haddock *Sebastes marinus*	"	muscle	W	1.5	"
" "	"	water soluble muscle	W	4.5	"
Tuna *Thunnus spp.*	(low Hg)		D	(1.71-2.16) 1.91	Ganther et al. (1972)
" "	(high Hg)		D	(2.43-3.4)2.91	"

SELENIUM IN FRESHWATER FISH (1)

Species	Locality	Tissue	Analysis (2) PPM		Authority
Shortnose sturgeon *Acipenser brevirostrum*	New York	muscle	W	0.37	Pakkala et al. (1972)
Atlantic sturgeon *Acipenser oxyrhynchos*	"	"	W	(0.26-0.84)	"
Alewife *Alosa pseudoharengus*	Great Lakes		W	(0.001-0.002)	Lucas et al. (1970)
Rock bass *Ambloplites rupestris*	New York	muscle	W	(0.15-0.98)	Pakkala et al. (1972)
" "	United States	whole	W	(0.27-0.80)	Walsh et al. (1977)
Bowfin *Amia calva*	New York	muscle	W	0.15	Pakkala et al. (1972)
Freshwater drum *Aplodinotus grunniens*	"	"	W	(0.11-0.81)	"
" "	Lake Erie	"	W	(0.47-0.79)	Willford (1971)
Barb *Barbus barbus plebejus*	Italy		W	(0.2-0.336) 0.28	Rossi et al. (1976)

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Goldfish *Carassius auratus*	Great Lakes	liver	W	(0.001-0.002)	Lucas et al. (1970)
" "	New York	muscle	W	(0.14-0.18)	Tong et al. (1972)
" "	United States	whole	W	(0.26-0.30)	Walsh et al. (1977)
River carpsucker *Carpiodes carpio*	"	"	W	(0.28-0.40)	"
Longnose sucker *Catostomus catostomus*	"	"	W	(0.33-0.58)	"
Bridgelip sucker *Catostomus columbianus*	"	"	W	(0.20-0.26)	"
White sucker *Catastomus commersoni*	New York	muscle	W	(0.18-0.72)	Pakkala et al. (1972a)
" "	Lake Erie	"	W	(0.40-0.49)	Willford (1971)
" "	United States	whole	W	(0.07-0.92)	Walsh et al. (1977)
Largescale sucker *Catostomus macrocheilus*	"	"	W	(0.06-0.38)	"
Lake herring *Coregonus artedii*	Great Lakes	liver	W	(0.001-0.002)	Lucas et al. (1970)
" "	New York	muscle	W	(0.30-0.36)	Tong et al. (1972)
Lake whitefish *Coregonus clupeaformis*	Great Lakes	liver	W	(0.001-0.002)	Lucas et al. (1970)
" "	Manitoba	muscle, bone & skin	W	0.24	Uthe & Bligh (1971)
" "	Lake Ontario	"	W	0.38	"
" "	New York	muscle	W	(0.32-0.97)	Pakkala et al. (1972a)

Bloater *Coregonus hoyi*	Lake Ontario	liver	W	(0.001-0.002)	Lucas et al. (1970)
" "	United States	whole	W	(0.32-0.49)	Walsh et al. (1977)
Slimy sculpin *Cottus cognatus*	Great Lakes		W	(0.64-0.67)	Thomas (1972)
Carp *Cyprinus carpio*	New York	muscle	W	0.21	Pakkala et al. (1972a)
" "	United States	whole	W	(0.20-6.0)	Walsh et al. (1977)
" "	Lake Erie	muscle	W	(0.50-0.58)	Willford (1971)
Gizzard shad *Dorosoma cepedianum*	New York	"	W	0.42	Pakkala et al. (1972a)
" "	Lake Erie	"	W	(0.35-0.42)	Willford (1971)
" "	United States	whole	W	(0.24-1.10)	Walsh et al. (1977)
Northern pike *Esox lucius*	Manitoba	muscle, bone, & skin	W	(0.17-0.37)	Uthe & Bligh (1971)
" "	Lake Erie	"	W	0.19	"
" "	New York	"		(0.15-0.55)	Pakkala et al. (1972a)
Muskellunge *Esox masquinongy*	"	muscle	W	(0.15-0.27)	"
Chain pickerel *Esox niger*	"	"	W	(0.23-0.52)	"
" "	United States	whole	W	(0.05-0.92)	Walsh et al. (1972)
Goldeye *Hiodon alosoides*	"	"	W	(0.18-3.50)	" (1977)

Mooneye *Hyodon tergisus*	United States	whole	W	0.52	Walsh et al. (1977)
White catfish *Ictalurus catus*	"	"	W	(0.17-0.25)	"
Blue catfish *Ictalurus furcatus*	"	"	W	(0.12-0.38)	"
Brown catfish *Ictalurus nebulosus*	New York	muscle	W	(0.10-0.48)	Pakkala et al. (1972a)
Yellow bullhead *Ictalurus notatus*	United States	whole	W	(0.13-3.10)	Walsh et al. (1977)
Channel catfish *Ictalurus punctatus*	New York	muscle	W	(0.11-0.14)	Pakkala et al. (1972a)
" "	Lake Erie	"	W	(0.29-0.34)	Willford (1971)
" "	United States	whole	W	(0.18-1.30)	Walsh et al. (1977)
Spotted gar *Lepisosteus oculatus*	"	"	W	0.28	"
Longnose gar *Lepidosteus osseus*	"	"	W	(0.40-0.56)	"
Red breast sunfish *Lepomis auritus*	"	"	W	(0.42-0.52)	"
Pumpkinseed *Lepomis gibbosus*	"	"	W	(0.22-0.35)	"
Blue gill *Lepomis macrochirus*	"	"	W	(0.16-1.10)	"
Leuciscus cephalus cabeda	Italy		W	(0.091-0.29) 0.19	Rossi et al. (1976)
Burbot *Lota lota*	New York	muscle	W	0.33	Pakkala et al. (1972a)
Peamouth *Meilocheilus caurinus*	United States	whole	W	0.84	Walsh et al. (1977)

Smallmouth bass *Micropterus dolomieui*	New York	muscle	W	(0.15-0.84)	Pakkala et al. (1972a)
" "	Lake Erie	"	W	0.36	Willford (1971)
" "	United States	whole	W	(0.08-0.70)	Walsh et al. (1977)
Largemouth bass *Micropterus salmoides*	New York	muscle	W	(0.11-0.57)	Pakkala et al. (1972a)
" "	United States	whole	W	(ND-4.0)	Walsh et al. (1977)
Spotted sucker *Minytrema melanops*	"	"	W	(0.38-2.12)	"
White bass *Morone chrysops* (=Roccus chrysops)	New York	muscle	W	(0.32-0.52)	Pakkala et al. (1972a)
" "	Lake Erie	"	W	(0.46-0.62)	Willford (1971)
" "	United States	whole	W	(0.56-2.10)	Walsh et al. (1977)
" "	Great Lakes	liver	W	(0.001-0.002)	Lucas et al. (1970)
Striped bass *Morone saxatilis*	New York	muscle	W	(0.24-0.65)	Pakkala et al. (1972a)
Striped mullet *Mugil cephalus*	United States	whole	W	(0.28-0.42)	Walsh et al. (1977)
River chub *Nocomis micropogon*	"	"	W	(0.48-0.68)	"
Golden shiner *Notemigonus chrysoleucas*	"	"	W	(0.23-0.72)	"
Spotted shiner *Notropis hudsonius*	Great Lakes	liver	W	(0.001-0.002)	Lucas et al. (1970)

Coho salmon *Onchorynchus kisutch*	New York	muscle	W	(0.18-0.68)	Pakkala et al. (1972a)
" "	Lake Erie	"	W	(0.36-0.52)	Willford (1971)
Sacramento blackfish *Orthodon microlepidnotus*	California	whole	W	0.30	Walsh et al. (1977)
American smelt *Osmerus mordax*	Great Lakes	liver	W	(0.001-0.002)	Lucas et al. (1970)
" "	"		W	(0.39-0.66)	Thomas (1972)
" "	Lake Erie	muscle, bone, & skin	W	0.22	Uthe & Bligh (1971)
" "	United States	muscle	W	1.23	Schroeder et al. (1970)
" "	Lake Erie	whole	W	0.34	Willford (1971)
Yellow perch *Perca flavescens*	Great Lakes	liver	W	(0.001-0.002)	Lucas et al. (1970)
" "	Lake Erie	muscle, bone & skin	W	0.32	Uthe & Bligh (1971)
" "	New York	muscle	W	(0.18-0.36)	Pakkala et al. (1972a)
" "	Lake Erie	"	W	(0.38-0.51)	Willford (1971)
" "	United States	whole	W	(0.05-0.80)	Walsh et al. (1977)
Trout perch *Percopsis omiscomaycus*	Great Lakes	liver	W	(0.001-0.002)	Lucas et al. (1970)
White crappie *Pomoxis annularis*	United States	whole	W	(0.14-1.20)	Walsh et al. (1977)

Black crappie *Pomoxis nigromaculatus*	New York	muscle	W	(0.20-0.47)	Pakkala et al. (1972a)
" "	United States	whole	W	(0.12-0.70)	Walsh et al. (1977)
Round whitefish *Prosopium cylindroceum*	Great Lakes	liver	W	(0.001-0.002)	Lucas et al. (1970)
Round whitefish *Prosopium cylindraceum*	Alaska	whole	W	(ND-1.40)	Walsh et al. (1977)
Northern squawfish *Ptychocheilus oregonensis*	United States	"	W	(0.04-0.40)	"
Rutilus rubilio	Italy		W	(0.141-0.538) 0.284	Rossi et al. (1976)
Brown trout *Salmo trutta*	New York	muscle	W	(0.24-0.44)	Pakkala et al. (1972a)
Salmon *Salmo trutta fario*	Italy		W	(0.129-0.261) 0.195	Rossi et al. (1976)
Brook trout *Salvelinus fontinalis*	New York	muscle	W	(0.40-1.10)	Pakkala et al. (1972a)
Lake trout *Salvelinus naymaycush*	Great Lakes	liver	W	(0.001-0.002)	Lucas et al. (1970)
" "	New York	muscle	W	(0.23-1.50)	Pakkala et al. (1972a)
" "	United States	whole	W	(0.24-0.80)	Walsh et al. (1977)
Sauger *Stizostedion canadense*	"	"	W	(0.36-0.61)	"
Walleye pike *Stizostedion vitreum vitreum*	Great Lakes	liver	W	(0.001-0.002)	Lucas et al. (1970)
" " "	"		W	(0.40-0.68)	Thomas (1972)
" " "	Lake Erie		W	(0.33-0.34)	Pillay et al. (1972)

Walleye pike *Stizostedion vitreum vitreum*	New York	muscle	W	(0.17-0.40)	Pakkala et al. (1972a)
" " "	Lake Erie	"	W	(0.28-0.48)	Willford (1971)
Arctic grayling *Thymallus arcticus*	Alaska	whole	W	(1.2-1.3)	Walsh et al. (1977)

SELENIUM IN LOWER ANIMALS(1)

Species	Locality	Tissue	Analysis(2) PPM		Authority
MOLLUSCA					
Ark shell *Anadara spp.*	East Asia	soft parts	W	0.002	Leung (1973)
Ark shell *Arca spp.*	"	"	W	0.002	"
Oyster *Crassostrea cucullata*	India	"	A	13.57 pCi/g ^{75}Se	Patel & Ganguly (1973)
" "	"	"	A	5.40 " "	"
Oyster *Crassostrea gryphoides*	"	"	A	6.21 " "	"
American oyster *Crassostrea virginica*	United States	"	W	0.49	Schroeder et al. (1970)
Mussel *Mytilus edulis*	Sweden	"	W	3.9	Lunde (1970)
" "	"	water soluble soft parts	W	1.1	"

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Scallop *Pecten maximus*	Sweden	soft parts	W	2.6	Lunde (1970)
" "	"	water soluble soft parts	W	1.0	"
Squid *Ommastrephes sagittatus*	"	soft parts	W	3.0	"
" "	"	water soluble soft parts	W	0.6	"
Oyster *Ostrea edulis*	"	soft parts	W	ND	"
" "	"	water soluble soft parts	W	0.9	"
"Scallops"	New England		W	0.77	Schroeder et al. (1970)
"Clams"	"	soft parts	W	0.55	"
CRUSTACEA					
Copepod *Acartia clausi*	Greece	whole	D	(1.01-3.08) 1.86	Zafiropoulos & Grimanis (1977)
Crab *Cancer anthonyi*	S. California (non-contam. area)		W	15.66±SE 2.75	Fowler et al. (1975)
" "	" (contam. area)		W	5.14±SE 0.96	"
Shrimp	United States		W	(1.74-2.02)	Schroeder et al. (1970)
American lobster *Homarus americanus*	New England	muscle	W	1.04	"

Lobster *Homarus vulgaris*	Sweden	muscle	W	1.5	Lunde (1970)
" "	"	" soluble	W	2.0	"
Shrimp *Palaemon spp.*	East Asia		W	0.58	Leung (1973)
King crab *Paralithodes camschatica*		canned muscle	W	0.51	Schroeder et al. (1970)
Sowbug, woodlice *Porcellio sp.*	Denmark	whole	W	0.87	Gissel-Nielsen (1974)
ECHINODERMATA					
Sea urchin *Arbacia lixula*	Greece	"	D	2.4	Papadopoulou et al. (1976)
Sea urchin *Echinaster sepositus*	"	"	D	4.4	"
Sea cucumber *Holothuria tubulosa*	"	"	D	3.4	"
Starfish *Marthasterias glacialis*	"	"	D	3.0	"
Serpent star *Ophioderma longicauda*	"	"	D	1.9	"
Sea urchin *Paracentrotus lividus*	"	"	D	1.1	"
Sea urchin *Sphaerechinus granularis*	"	"	D	0.80	"
INSECTA					
Bruchid beetle *Acanthoscelides fraterculus*		larva		67.0	Rosenfeld & Beath (1964)
Seed chalcid *Bruchophagus mexicanus*		"		67.0	"
Blister beetle *Lytta nuttalli*	(fed on Astragalus flowers with 2300 ppm Se)	adult		21.0	"

Crane fly *Tipula sp.*	Denmark	larva	W	0.93	Gissel-Nielsen (1974)
"Fly larvae"	United States (on Astragalus with 1800 ppm Se)	"	W	20.0	Rosenfeld & Beath (1964)
ARACHNIDA					
Centipede *Lithobius sp.*	Denmark	whole	W	1.64	Gissel-Nielsen (1974)
TUNICATA					
Tunicate *Ciona intestinalis*	Greece	"	W	0.051	Papadopoulou & Kanias (1977)
" "	"	"	D	1.2	"
" "	"	tunic	W	0.040	"
" "	"	"	D	1.0	"
" "	"	rest of body	W	0.11	"
" "	"	"	D	2.7	"
Tunicate *Microcosmus sulcatus*	"	whole	W	2.8	"
" "	"	"	D	5.1	"

SELENIUM IN HIGHER PLANTS(1)

Species	Locality	Tissue	Analysis(2) PPM		Authority
Western wheat grass Agropyron smithii	South Dakota	top	D	(0.0-84.0)11.5	Rosenfeld & Beath (1964)
Onion Allium cepa	East Asia	bulb	W	0.015	Leung (1973)
" "	W. United States (Se area)	"	D	(0.40-17.8)	Rosenfeld & Beath (1964)
Garlic Allium sativum	East Asia	"	W	0.771	Leung (1973)
Pineapple Ananas comosus	"	fruit	W	0.005	"
Little bluestem Andropogon scoparius	W. United States	top	D	(0.0-6.0) 1.1	Rosenfeld & Beath (1964)
Peanut Arachis hypogaea	Lower Dahomey	nut	D	0.21	Cresta et al. (1975)
Big sagebrush Artemisia tridentata	Idaho	branch	D	(0.06-1.2)	Gough & Severson (1976)

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Asparagus *Asparagus oficinale*	W. United States (Se area)		D	(2.70-11.0)	Rosenfeld & Beath (1964)
Aster *Aster caerulescens*	" "		D	560	"
Aster *Aster commutatis*	" "		D	(15.0-590.0)	"
Aster *Aster multiflora*	" "		D	(0.0-320.0)62.0	"
Aster *Aster occidentalis*	" "		D	284.0	"
Woody aster *Aster venustus*	United States	Indicator of economic deposits of Se			Cannon (1971)
Woody aster *Aster xylorrhiza*	"	" " (Requires Se)			"
Poison vetch *Astragalus albulus*	W. United States	Indicator of economic deposits of Se			"
Milk vetch *Astragalus argillosus*	"	top	D	385.0	Rosenfeld & Beath
" "	"	root	D	27.0	"
Milk vetch *Astragalus beathii*	"	top	D	1,963	"
" "	"	root	D	66.0	"
Milk vetch *Astragalus bisulcatus*	"		D	10,239	Cannon (1974)
" "	"	top	D	(1.0-10,239)	Rosenfeld & Beath (1964)
" "	"	seed	D	3051	"
Milk vetch *Astragalus confertiflorus*	"	top	D	1,372	"
Milk vetch *Astragalus crotalariae*	"	"	D	2000	"

Milk vetch *Astragalus crotalariae*	W. United States	root	D	45.0	Rosenfeld & Beath (1964)
Milk vetch *Astragalus diholcos*	"	Indicator of economic deposits of Se			Cannon (1971)
Milk vetch *Astragalus eastwoodi*	"	" " "			"
Milk vetch *Astragalus elisiae*	"	" " "			"
Milk vetch *Astragalus garbancillus*	Peru, Andes	Used to locate U and Se ore			"
Milk vetch *Astragalus grayii*	W. United States	top	D	350.0	Rosenfeld & Beath (1964)
" "	"	Indicator of economic deposits of Se			Cannon (1971)
Milk vetch *Astragalus moenkopensis*	"	" " "			"
Milk vetch *Astragalus oocalysis*	"	" " "			"
Milk vetch *Astragalus osterhouti*	"	seed	D	3,000	Rosenfeld & Beath (1964)
" "	"	top	D	1,308	"
Milk vetch *Astragalus pattersoni*	"		D	8,512.0	Cannon (1974)
" "	"	top	D	(1.5-5119)	Rosenfeld & Beath (1964)
" "	"	seed	D	3,300	"
Milk vetch *Astragalus pectinatus*			D	(10.0-10,239)	"
" "		Indicator of economic deposits of Se			Cannon (1971)
Milk vetch *Astragalus preussi*	"		D	1,770	"
Milk vetch *Astragalus racedens*	"	Indicator of economic deposits of Se			"

Milk vetch *Astragalus racemosus*	W. United States	top	D	(1.0-14,920)	Rosenfeld & Beath (1964)
" "	"	seed	D	3,000	"
Milk vetch *Astragalus sabulosus*	"	top	D	1,066	"
Locoweed *Astragalus spp.*		24 spp. can contain 1000 ppm Se			Harr & Muth (1972)
" "	(in uranium districts)		A	46,000 (max.)	Cannon (1969)
" "	"		D	6,000 (max.)	"
Saltbush *Atriplex canescens*	United States		D	477.0	Rosenfeld & Beath (1964)
Salt bush *Atriplex confertifolia*	"		D	1,734	"
Salt bush *Atriplex nuttallii*	"		D	(300-502)	"
Oats *Avena sativa*	Sweden	plant	D	(0.009-0.033)	Lindberg & Lannek (1970)
" "	W. United States (Se area)	"	D	(2.0-15.0)	Rosenfeld & Beath (1964)
Swiss chard *Beta vulgaris cicla*	United States		D	0.08	Furr et al. (1976)
" " "	" (soil amended with sludge)		D	(0.05-0.06)	"
Side oat grass *Bouteloua curtipendula*	W. United States		D	(0.0-32.0)3.6	Rosenfeld & Beath (1964)
Buffalo grass *Bouteloua dactyloides*	"		D	(0.0-12.0)2.7	"
Blue grama *Bouteloua gracilis*	"		D	(0.0-3.6)1.4	"

Cauliflower *Brassica oleracea botrytis*	East Asia	flower	W	0.006	Leung (1973)
" " "	Italy		W	0.004	Rossi et al. (1976)
Cabbage *Brassica oleracea capitata*	East Asia		W	0.022	Leung (1973)
" " "	W. United States (Se area)		D	(2.3-4.5)	Rosenfeld & Beath (1969)
Turnip *Brassica rapa*	East Asia	leaf	W	0.007	Leung (1973)
Scotch heather *Calluna vulgaris*	Finland		D	<10.0	Koljonen (1974)
Tea *Camellia sinensis*		leaf		0.115±0.0274	Shah et al. (1971)
Pepper *Capsicum annuum*	East Asia	fruit	W	0.007	Leung (1973)
Chestnut *Castanea sp.*	Italy		W	<0.004	Rossi et al. (1976)
Indian paint brush *Castilleja angustifolia*	United States		D	250	Rosenfeld & Beath (1964)
Indian paint brush *Castillaja chromosa*	"		D	1,812	"
Chickweed *Cerastium holosteoides*	Great Britain		D	(6.7-21.5)	Nye & Peterson (1975)
Thistle *Cirsium palustre*	"		D	(ND-108.5)	"
Tangerine *Citrus reticulata*	East Asia	fruit	W	0.004	Leung (1973)
Coffee *Coffea arabica*		bean		(0.004-0.167)	Shah et al. (1971)

Taro *Colocasia esculenta*	East Asia	root	W	0.054	Leung (1973)
" "		leaf stalk	W	0.002	"
Comandra pallida	W. United States		D	140.0	Rosenfeld & Beath (1964)
Cucumber *Cucumis sativus*	East Asia	fruit	W	0.003	Leung (1973)
" "	W. United States (Se area)	"	D	(0.1-0.6)	Rosenfeld & Beath (1964)
Cocksfoot *Dactylis glomerata*	Sweden		D	0.061	Lindberg & Lannek (1970)
" "	Great Britain	top	D	(20.7-42.8)	Nye & Peterson (1975)
Carrot *Daucus carota*	Italy		W	<0.004	Rossi et al. (1976)
" "	East Asia	root	W	0.022	Leung (1973)
" "	W. United States	"	D	(1.3-1.4)	Rosenfeld & Beath (1964)
Fescue *Festuca rubra*	Great Britain	top	D	(15.1-35.3)	Nye & Peterson (1975)
Meadow fescue *Festuca sp.*	Sweden		D	0.064	Lindberg & Lannek (1970)
Strawberry *Fragaria sp.*	Italy		W	<0.004	Rossi et al. (1976)
Bedstraw *Galium aparine*	Great Britain		D	(ND-15.0)	Nye & Peterson (1975)
Ginkgo *Ginkgo biloba*	East Asia	seed	W	0.011	Leung (1973)

Soybean *Glycine max*	East Asia	seed	W	0.015	Leung (1973)
" "	"	curd	W	0.003	"
Gumweed *Grindelia squarrosa*	W. United States		D	(0.0-260.0) 38.0	Rosenfeld & Beath (1964)
Broomweed *Gutierrezia diversifolia*	"		D	723	"
Broomweed *Gutierrezia sarothrae*	"		D	(8.0-220.0) 60.0	"
Haplopappus condensata			D	(680-4800)	"
Haplopappus engelmanni	"		D	101.0	"
Haplopappus fremontii	"	top	D	4,800	"
" "	"	root	D	4,800	"
Haplopappus (*Oonopsis*) *spp.*				800.0	"
Yorkshire fog *Holcus lanatus*	Great Britain		D	(15.4-33.8)	Nye & Peterson (1975)
Barley *Hordeum vulgare*	Sweden	top	D	(0.007-0.022)	Lindberg & Lannek (1970)
" "	East Asia	grain	W	0.66	Leung (1973)
" "	United States	"	W	(0.050-0.064)	Haller et al. (1969)
" "	" (Se area)		D	(1.7-17.0)	Rosenfeld & Beath (1964)
Limonillo *Hymenoxys floribunda*	W. United States		D	575	"
Sweet potato *Ipomoea batatas*	East Asia	root	W	0.071	Leung (1973)
Lettuce *Lactuca sativa*	"	leaf	W	0.008	"
" "	Italy		W	0.004	Rossi et al. (1976)

Prickly lettuce *Lactuca scariola*	East Asia	leaf	W	0.64	Leung (1973)
Flax *Linum usitatissimum*	Sweden		D	0.006	Lindberg & Lannek (1970)
Perennial ryegrass *Lolium perenne*	Great Britain		D	(ND-18.7)	Nye & Peterson (1975)
Tomato *Lycopersicon esculentum*	Italy		W	<0.004	Rossi et al. (1976)
" "	Lower Dahomey		D	<0.005	Cresta et al. (1975)
" "	W. United States (Se area)	fruit	D	(0.2-1.2)	Rosenfeld & Beath (1964)
" "	East Asia	"	W	0.005	Leung (1973)
Tansy aster *Machaeranthera sp.*	W. United States		D	(1.0-10,239)	Rosenfeld & Beath (1964)
Tansy aster *Machaeranthera glabriuscula*	"		D	(79.0-1,800)	"
Tansy aster *Machaeranthera ramosa*	"		D	1,345	"
Tansy aster *Machaeranthera venusta*	"		D	3,486	"
Apple *Malus sylvestris*	East Asia	fruit	W	0.002	Leung (1973)
" "	United States	"	W	0.022±0.007	Haller et al. (1969)
Cassava *Manihot utilissima*	Lower Dahomey	root	D	(<0.05-0.1)	Cresta et al. (1975)
" "	"	leaf	D	<0.1	"
Alfalfa *Medicago sativa*	Sweden	leaf & stem	D	0.04	Lindberg & Lannek (1970)

Sago Metroxylon spp.	East Asia		W	0.04	Leung (1973)
Banana Musa sapientum	"	fruit	W	0.009	"
Tobacco Nicotiana tabacum	United States	leaf	D	5.8	Nadkarni et al. (1970)
" "	"	stem	D	44.2	"
Rice Oryza sativa	East Asia	brown	W	0.38	Leung (1973)
" "	"	milled	W	0.318	"
" "	Lower Dahomey		D	(<0.05-0.13)	Cresta et al. (1975)
" "	United States		W	(0.090-0.115)	Haller et al. (1969)
Indian rice grass Oryzopsis hymenoides	Utah		D	93.0	Rosenfeld & Beath (1964)
Butterbur Petasites japonicus	East Asia	leaf	W	0.20	Leung (1973)
Beans Phaseolus spp.	Lower Dahomey	bean	D	(<0.05-0.09)	Cresta et al. (1975)
" "	"	leaf	D	0.08	"
" "	United States	bean	W	0.061	Haller et al. (1969)
" "	"	"	D	(0.2-2.0)	Rosenfeld & Beath (1964)
Timothy Phleum pratense	Sweden		D	0.018	Lindberg & Lannek (1970)
Peas Pisum sativum	East Asia		W	0.004	Leung (1973)
" "	United States	seed	W	<0.001	Haller et al. (1969)
Pear Pyrus communis	"	fruit	W	0.021±0.007	"

Radish *Raphanus sativus*	East Asia	root	W	0.039	Leung (1973)
Blackberry *Rubus sp.*	Italy	fruit	W	<0.004	Rossi et al. (1976)
Sour dock *Rumex acetosa*	Great Britain		D	(54.1-86.0)	Nye & Peterson (1975)
Rye *Secale cereale*	W. United States (Se area)		D	(0.90-25.0)	Rosenfeld & Beath (1964)
Sesame *Sesamum orientale*	East Asia		W	0.008	Leung (1973)
Spinach *Spinacia oleracea*	Lower Dahomey		D	(0.11-0.9)	Cresta et al. (1975)
Eggplant *Solanum melongena*	East Asia	fruit	W	0.067	Leung (1973)
Potato *Solanum tuberosum*	"	tuber	W	0.005	"
" "	W. United States		D	(0.2-0.9)	Rosenfeld & Beath (1964)
Prince's plume *Stanleya bipinnata*	"		D	(250.0-2,380) 700.0	"
Prince's plume *Stanleya integrifolia*	"	top	D	695	"
Prince's plume *Stanleya pinnata*	California	leaf & stem		(10.6-73.4)	Chessin (1972)
" "	W. United States	top	D	(125-804)	Rosenfeld & Beath (1964)
" "	"	root	D	429	"
Spanish moss *Tillandsia usnoides*	S.E. United States	whole	D	1.0	Shacklette & Connor (1973)

Townsendia incana	W. United States	Indicator of Se			NASA (1968)
Red clover *Trifolium pratense*	Sweden	plant	D	0.018	Lindberg & Lannek (1970)
Wheat *Triticum aestivum*	East Asia	grain	D	0.28	Leung (1973)
" "	"	"	W	0.004	"
" "	W. United States (Se area)	"	D	(1.15-30.0)	Rosenfeld & Beath (1964)
" "	" "	"	D	35.0	"
" "	" "	stem & leaf	D	17.0	"
" "	" "	root	D	36.0	"
Cowpeas *Vigna spp.*	East Asia	seed	W	0.015	Leung (1973)
Xylorhiza parri	United States	Indicator of Se			NASA (1968)
Corn *Zea mays*	East Asia	grain	W	0.3	Leung (1973)
" "	W. United States (Se area)	"	D	(1.0-20.0)	Rosenfeld & Beath (1964)
" "	Lower Dahomey	"	D	(<0.05-0.15)	Cresta et al. (1975)
Grape *Vitis sp.*	United States	raisin	W	<0.001	Haller et al. (1969)

SELENIUM IN LOWER PLANTS (1)

Species	Locality	Tissue	Analysis (2) PPM	Authority
FUNGI				
Mushroom *Agaricus spp.*	East Asia	whole	W 0.13	Leung (1973)
Fly mushroom *Amanita muscaria*	Yugoslavia	stalk	D (1.06-1.48)	Kosta et al. (1974)
" "	"	cap	D (3.24-4.21)	"
Amanita pantherina	"	whole	D 2.01	"
Amanita phalloides	"	stalk	D 0.19	"
" "		cap	D 0.33	"
Pore mushroom *Boletus sp.*	"	whole	W 0.13±SD 0.02	Bombace et al. (1974)
" "	"	stalk	W 0.13±SD 0.02	"
Coprinus comatus	"	whole	D 0.34	Kosta et al. (1974)
Cortinarius praestans	"	"	D 1.03	"
Cortinarius saturatus	"	"	D 0.63	"
Hygrocybe punicea	"	"	D (0.58-0.66)	"
Hypholoma fasciculare	"	"	D (0.28-0.33)	"

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Lactarius deliciosus	Yugoslavia	whole	D	(0.18-0.88)	Kosta et al. (1974)
Lactarius torminosus	"	"	D	1.28	"
Lycoperdon perlatum	"	spore	D	(3.09-7.02)	"
" "	"	whole	D	3.56	"
Macrolepiota procera	"	cap	D	(1.79-2.39)	"
Ramaria pallida	Yugoslavia	whole	D	1.88	Kosta et al. (1974)
Sarcodon imbricatum	"	"	D	1.69	"
Suillus bovinus	"	"	D	0.49	"
"Mushroom"	Italy		W	(<0.004-0.13)	Rossi et al. (1976)
"Fungi"			D	2.0	Bowen (1966)
ALGAE					
Brown alga *Egregia sp.*	California			0.09	Chessin (1972)
Brown alga *Laminaria hyperborea*			D	0.05	Lunde (1970a)
Brown alga *Laminaria japonica*	East Asia		D	0.02	Leung (1973)
Brown alga *Laminaria sp.*	California			0.03	Chessin (1972)
Elk kelp *Pelagophycus porra*	S. California	bladder	W	(0.15-2.2)	Folsom et al. (1972)
" "	"	blade	W	(0.03-0.10)	"
" "	"	stipe	W	(0.10-0.47)	"
Seaweed *Undaria pinnatifida*	East Asia		D	0.013	Leung (1973)
Microalgae, green	Germany		D	(0.1-0.7) 0.3	Payer et al. (1975)
" "	Bangkok		D	(0.01-0.15) 0.05	"

Brown algae		D	0.84	Bowen (1966)
Marine algae	California		1.93	Chessin (1972)

TIN IN MAMMALS(1)

Species	Locality	Tissue	Analysis PPM(2)		Authority
Cow Bos bovis	Vermont	muscle	W	(0.51-2.76)	Schroeder et al. (1964)
" "	"	muscle & fat	W	3.44	"
" "	"	bone marrow	W	0.42	"
" "	"	milk	W	0.68	"
" "	United States	dry skim milk	W	0.96	"
" "	Vermont	"	W	0.19	"
" "	Great Britain	"	W	0.0078± 0.0012	Hamilton et al. (1972)
Beaver Castor canadensis	Vermont	heart	W	7.28	Schroeder et al. (1964)
Guinea pig Cavia porcellus	United States (fed on swiss chard grown on sludge-amended soil)	liver	D	(1.8-7.4)4.8	Furr et al. (1976)

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Guinea pig *Cavia porcellus*	United States (fed on swiss chard grown on sludge-amended soil)	kidney	D	(<0.5-5.9)2.9	Furr et al. (1976)
" "	" "	muscle	D	(<0.5-2.8)1.9	"
" "	" "	adrenal	D	(7.7-15.0)10.2	"
" "	" "	spleen	D	(<0.5-2.4)1.6	"
Woodchuck *Marmota monax*	Vermont	liver	W	1.77	Schroeder et al. (1964)
White-tailed deer *Odocoilus virginianus*	"	"	W	0.82	"
" "	"	kidney	W	(1.65-2.20)	"
" "	"	heart	W	0.0	"
" "	Tennessee	kidney	W	0.0	"
Muskrat *Oudatra zibethica*	Vermont	liver	W	0.33	"
Sheep *Ovis aries*	"	"	W	0.32	"
" "	"	muscle	W	1.36	"
Harbor seal *Phoca vitulina*	Scotland	blood	W	0.02±0.01	Hamilton (1976)
" "	"	spleen	W	0.05±0.02	"
" "	"	heart	W	0.03±0.01	"
" "	"	muscle	W	0. 1±0.04	"
" "	"	kidney	W	0.08±0.02	"
" "	"	liver	W	0.1±0.05	"
Pig *Sus scrofa*	Vermont	muscle	W	0.84	Schroeder et al. (1964)
Red fox *Vulpes fulva*	"	liver	W	3.50	"

TIN IN BIRDS(1)

Species	Locality	Tissue	Analysis(2) PPM	Authority
Ruffed grouse *Bonasa umbellus*	Vermont	liver	W 0.50	Schroeder et al. (1964)
Chicken *Gallus gallus*	"	muscle	W 1.73	"
" "	"	egg	W 0.91	"

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TIN IN MARINE FISH (1)

Species	Locality	Tissue	Analysis (2) PPM	Authority
Wrasse *Ctenolabrus rupestris*	Sweden		D 4.7	Noddack & Noddack (1940)
Codfish *Gadus morhua*?	Atlantic Ocean	muscle	W (0.49-3.67)	Schroeder et al. (1964)
Griella punctata	Japan		trace	Matida & Kumada (1969)
Halibut *Hippoglossus hippoglossus*	Atlantic Ocean	muscle	W 1.21	Schroeder et al. (1964)
Konosirus punctatus	Japan		trace	Matida & Kumada (1969)
Winter flounder, grey sole *Pseudopleuronectes americanus*	Newfoundland	muscle	W 3.21	Schroeder et al. (1964)
Sand smelt *Silago siharna*	Japan		trace	Matida & Kumada (1969)
Spiny dogfish *Squalus acanthius*	Sweden		D 2.0	Noddack & Noddack (1940)

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TIN IN FRESHWATER FISH (1)

Species	Locality	Tissue	Analysis (2) PPM	Authority
Sturgeon *Acipenser sp.*	New York	muscle, bone, skin	W 0.60	Tong et al. (1972)
White sucker *Catastomus commersoni*	"	"	W 1.5	"
Lake whitefish *Coregonus clupeaformis*	Manitoba, Moose Lake	muscle	W 3.57	Uthe & Bligh (1971)
" "	Lake Ontario	"	W 0.80	"
Bloater *Coregonus hoyi*	United States	smoked	W 4.3	Schroeder et al. (1964)
Carp *Cyprinus carpio*	New York	muscle, bone, & skin	W 0.15	Tong et al. (1972)
Northern pike *Esox lucius*	Manitoba, Moose Lake	muscle	W 5.43	Uthe & Bligh (1971)
" "	" Lake St. Pierre	"	W 0.67	"
" "	Lake Erie	"	W 0.54	"

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Northern pike *Esox lucius*	New York	muscle, bone & skin	W	(0.06-17.0)	Tong et al. (1972)
Muskellunge *Esox masquinongy*	"	"	W	(0.55-1.1)	"
Chain pickerel *Esox niger*	"	"	W	(0.17-4.1)	"
Smallmouth bass *Micropterus dolomieu*	"	"	W	(0.05-6.0)	"
Largemouth bass *Micropterus salmoides*	"	"	W	(0.55-3.6)	"
Striped bass *Morone saxatilis*	"	"	W	0.90	"
Rainbow smelt *Osmerus mordax*	Lake Erie	muscle	W	1.22	Uthe & Bligh (1971)
Yellow perch *Perca flavescens*	"	"	W	0.55	"
" "	New York	muscle, bone & skin	W	0.75	Tong et al. (1972)
Black crappie *Pomoxis nigromaculatus*	"	"	W	0.25	"
Lake trout *Salvelinus naymaycush*	"	"	W	(0.044-0.230)	" (1974)
" "	"	"	W	(0.23-0.80)	" (1972)
Walleye *Stizostedion vitreum*	"	"	W	(0.05-20.0)	"
"Fish"	Great Britain	Potato fields near reservoir were sprayed with triphenyl tin hydroxide and fish died.		100.0	Moore (1969)

TIN IN LOWER ANIMALS (1)

Species	Locality	Tissue	Analysis (2) PPM	Authority
MOLLUSCA				
Aeolidia papillosa	Great Britain		A 150.0	Webb (1937)
Sea hare *Aplysia benedicti*	India (in reactor waste)		A ND	Patel & Ganguly (1973)
Gastropod *Cellana radiata*	" "		A ND	"
Pteropod *Clione limocina*	New England	whole	A 20.0	Nicholls et al. (1959)
Oyster *Crassostrea cucullata*	India (in reactor waste)	soft parts	A (12.11-42.24) pCi/g Sn^{113}	Patel & Ganguly (1973)
Oyster *Crassostrea gryphoides*	" "	"	A 7.15 pCi/g Sn^{113}	"
American oyster *Crassostrea virginica*	Texas	shell	D <0.1	Smith & Wright (1962)
" "	Cape Cod	soft parts	W 1.38	Schroeder et al. (1964)

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Snail *Helix pomatia*	Great Britain		A	250.0	Webb (1937)
Clam *Hormomya mutabilis*	Japan			trace	Matida & Kumada (1969)
Pteropod *Limacina retroversa*	New England	whole	A	<1.0	Nicholls et al. (1959)
Mussel *Mytilus edulis*	Japan			trace	Matida & Kumada (1969)
Octopus *Octopus vulgaris*	"			"	"
Squid *Ommastrephes illecebrosa*	New England		A	3.0	Nicholls et al. (1959)
Gastropod *Onchidium verruculatum*	India (in reactor waste)		A	ND	Patel & Ganguly (1973)
Oyster *Ostrea edulis*	North Sea (after dumping munitions)			200.0	Orton (1924)
"Snails"	Great Britain	Potato fields sprayed near a reservoir with triphenyl tin hydroxide:		750.0	Moore (1969)
CRUSTACEA					
Copepod *Calanus finmarchius*	New England		A	<1.0	Nicholls et al. (1959)
" "	" (with 50% neritic phytoplankton)		A	90.0	"

Copepod Centropagus hamatus	New England		A	50.0	Nicholls et al. (1959)
Copepod Centropagus typicus	"		A	50.0	"
Euphausid Euphausia krohnii	"		A	<1.0	"
Lobster Homarus americanus	Maine	claw muscle	W	0.60	Schroeder et al. (1964)
ECHINODERMATA					
Starfish Asterias rubens	Sweden		D	7.2	Noddack & Noddack (1940)
" "	Great Britain		A	800.0	Webb (1937)
Sea urchin Brissopsis lyrifera	Sweden		D	1.6	Noddack & Noddack (1940)
Sea urchin Paracentrotus lividus	Great Britain (% wt. of ash cations)		A	800.0	Webb (1937)
Sea cucumber Stichopus tremulus	Sweden		D	6.2	Noddack & Noddack (1940)
COELENTERATA					
Sea pen Cavernularia obesa haberai	Japan			0.0	Matida & Kumada (1969)
Lions mane Cyanea capillata	New England	whole	A	4.0	Nicholls et al. (1959)
" "	"	"	D	2.5	"
" "	Sweden	"	D	32.0	Noddack & Noddack (1940)

Sea anemone *Metridium dianthus*	Sweden		D 15.0	Noddack & Noddack (1940)
PORIFERA				
Sponge *Halichondria sp.*	"		D 1.7	"
Sponge *Terpior zeteki*			accumulates Sn	Bowen (1966)
CTENOPHORA				
Comb jelly *Beroe cucumis*	New England	whole	A 7.0	Nicholls et al. (1959)
CHAETOGNATHA				
Arrow worm *Sagitta elegans*	"	"	A 20.0	"
TUNICATA				
Tunicate *Ciona intestinalis*	Sweden	"	D 3.5	Noddack & Noddack (1940)
Tunicate *Salpa fusiforme*	New England	"	A 8.0	Nicholls et al. (1959)
NEMERTEA				
Lineus longissimus	Great Britain		A 200.0	Webb (1937)

TIN IN HIGHER PLANTS (1)

Species	Locality	Tissue	Analysis (2) PPM	Authority
Norway maple *Acer platanoides*	New England	leaf	D <0.1	Smith (1973)
Sugar maple *Acer saccharum*	Vermont	"	W 0.18	Schroeder et al. (1964)
" "	"	"	D 0.53	"
" "	"	"	A 9.8	"
" "	New England	"	D <0.1	Smith (1973)
Garlic *Allium sativum*	United States	bud	W 0.3	Schroeder et al. (1964)
Asparagus *Asparagus officinalis*	Vermont	shoot	W 9.07	"
Oats *Avena sativa*	United States	grain	W 2.28	"
White mangrove *Avicennia alba*	Malaya	leaf	D 1.4	Peterson et al. (1976)
" "	" (on Sn drainage)	"	D 10.8	"

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Barberry *Berberis vulgaris*	Vermont	berry	W	0.10	Schroeder et al. (1964)
" "	"	"	D	0.50	"
" "	"	"	A	11.1	"
Swiss chard *Beta vulgaris cicla*	United States (grown in soil pH 5.5)		D	12.0	Furr et al. (1976)
" " "	" (" pH 6.5)		D	<0.5	"
" " "	"(soil mixed, pH 6.0)		D	8.0	"
" " "	"(soil sludge fortified, pH 6.5)		D	100.0	"
" " "	"(" " pH 5.5)		D	51.0	"
" " "	Vermont	leaf & stem	W	0.23	Schroeder et al. (1964)
White birch *Betula alba?*	"	leaf	W	0.0	"
Birch *Betula verrucosa*	Finland		A	(<10.0-10.0)	Lounamaa (1956)
Borrereria latifolia	Malaya	leaf	D	(1.5-1.8)	Peterson et al. (1976)
Kale *Brassica oleracea acephala*	Vermont	"	W	0.86	Schroeder et al. (1964)
Cabbage *Brassica oleracea capitata*	"	head	W	0.40	"
Turnip *Brassica rapa*	"	root	W	0.11	"
" "	"	leaf & stem	W	0.07	"

Mangrove *Bruguiera caryophylloides*	Malaya	leaf	D	1.3	Peterson et al. (1976)
" "	" (on Sn drainage)	"	D	9.4	"
Scotch heather *Calluna vulgaris*			Used in geochemical prospecting for Sn		Carlisle & Cleveland (1958)
Tea *Camellia sinensis*	Ceylon	leaf	W	2.28	Schroeder et al. (1964)
Sedge *Carex sp.*	Malaya	"	D	15.8	Peterson et al. (1976)
Cassia *Cassia leschenaultica*	"	"	D	18.1	"
Heather *Cassiope sp.*	Finland		A	6.0±SE 3.0	Lounamaa (1956)
Fern *Cyclosorus unitus*	Malaya	leaf	D	11.3	Peterson et al. (1976)
Sedge *Cyperus compressus*	" (near Sn smelter)	"	D	338.0	"
Tick trefoil *Desmodium triflorum*	"(on dune)	"	D	1.8	"
" "	"(Sn tailings pond)	"	D	9.8	"
Ehretia microphylla	" (near Sn smelter)	"	D	2,165.0	"
Crowberry *Empetrum nigrum*	Finland		A	6.0±SE 3.0	Lounamaa (1956)
Bonesat *Eupatorium odoratum*	Malaya (Sn tailings pond)	leaf	D	(4.9-10.0)	Peterson et al. (1976)

Spurge *Euphorbia hirta*	Malaya (near Sn smelter)	leaf	D	404.0	Peterson et al. (1976)
Fern *Gleichenia linearis*	"	"	D	(7.1-32.0)	"
Cudweed *Gnaphalium suaveolans*	Brazil	Used as an indicator of economic deposits of Sn.			Dorn (1937)
Barley *Hordeum vulgare*	United States	grain		0.65	Schroeder et al. (1964)
Ischaemum muticum	Malaya (dune)	leaf	D	2.6	Peterson et al. (1976)
" "	" (Sn tailings pond)	"	D	8.6	"
Lettuce *Lactuca sativa*	Vermont	"	W	0.07	Schroeder et al. (1964)
Alfalfa *Medicago sativum*	"	leaf & stem	W	2.92	"
" "	"	"	D	13.27	"
" "	"	"	A	161.1	"
Melastoma *Melastoma malabathricum*	Malaya (dune)	leaf	D	2.9	Peterson et al. (1976)
" "	" (Sn tailings pond)	"	D	6.8	"
" "	" "	"	D	(3.5-10.0)	"
Mimosa *Mimosa pudica*	"	"	D	(1.5-2.3)	"
" "	" (slag heap)	"	D	8.4	"
" "	" (near Sn smelter)	"	D	138.0	"

Rice Oryza sativa		grain	W	0.28	Schroeder et al. (1964)
Parsnip Pastinica sativa	Vermont	root	W	1.02	"
Bean Phaseolus vulgaris	California (grown in nutrient soln.)	"	D	2.7	Wallace & Romney (1977)
" "	" "	stem	D	0.5	"
" "	" "	leaf	D	1.3	"
" "	United States	dry bean	W	5.80	Schroeder et al. (1964)
" "	Vermont	string bean	W	0.28	"
Norway spruce Picea abies	New England	leaf	D	<0.1	Smith (1973)
Red spruce Picea rubra	Vermont	needle	W	0.0	Schroeder et al. (1964)
White pine Pinus strobus	"	"	W	0.37	"
" "	"	"	D	0.90	"
" "	"	"	A	23.1	"
Pea Pisum sativum	United States	dry pea	W	(1.92-8.50)	"
" "	"	fresh pea	W	(1.06-1.69)	"
Quaking aspen Populus tremuloides	Vermont	leaf	W	0.0	"
Peach Prunus persica	United States	fruit	W	0.0	"

Pin oak *Quercus palustris*	New England	leaf	D	<0.1	Smith (1973)
Red oak *Quercus rubra*	Vermont	"	W	0.0	Schroeder et al. (1964)
Radish *Raphanus sativus*	"	root	W	0.38	"
" "	"	leaf	W	0.0	"
Rhubarb *Rheum rhapsonticum*	"	stem	W	(1.29-1.88)	"
Mangrove *Rhizophora conjugata*	Malaya (Sn tailings pond)	leaf	D	2.4	Peterson et al. (1976)
" "	"	"	D	15.0	"
Rye *Secale cereale*	United States	grain	W	1.9	Schroeder et al. (1964)
Houseleek *Sempervivum soboliferum*	Germany	Used as an indicator of economic deposits of Sn			Krusch (1914)
Catchfly *Silene cucubalis*			A	20.0	Peterson (1971)
Potato *Solanum tuberosum*	Vermont	tuber	W	0.97	Schroeder et al. (1964)
Mountain ash *Sorbus americana*	"	berry	W	0.10	"
" "	"	"	D	0.50	"
" "	"	"	A	11.1	"
Spinach *Spinacia oleracea*	"	leaf & stem	W	(0.89-1.23)	"
" "	New York	fresh packaged	W	6.47	"

Yew *Taxus spp.*	New England	leaf	D	<0.1	Smith (1973)
Spanish moss *Tillandsia americana*	United States	whole	A	(20.0-30.0) geom. mean 21.0 ±geom. dev. 1.80	Shacklette & Connor (1973)
Tridax procumbens	Malaya (near Sn smelter)	leaf	D	700.0	Peterson et al. (1976)
" "	" (slag heap)	"	D	21.7	"
European starflower *Trientalis europaea*	Bohemia		Used as an indicator of economic deposits of Sn		Krusch (1914)
Red clover *Trifolium pratense*	Vermont	leaf & stem	W	0.38	Schroeder et al. (1963)
" "	"	"	D	2.11	"
" "	"	"	A	13.3	"
Wheat *Triticum vulgare*	Japan	grain	W	0.47	"
" "	United States	"	W	0.0	"
" "	"	hard wheat	D	5.6±SD 0.6	Zook et al. (1970)
" "	"	soft wheat	D	7.9±SD 0.9	"
" "	"	durum wheat	D	6.8±SD 0.5	"
Eastern hemlock *Tsuga canadensis*	New England	needle	D	<0.1	Smith (1973)

Elm *Ulmus americana*	Vermont	wood, 40 yr.	W 1.70	Schroeder et al. (1969)
" "	"	" "	D 1.79	"
" "	"	" "	A 255.0	"
" "	"	" 80 yr.	W 1.39	"
" "	"	" "	D 1.47	"
" "	"	" "	A 154.0	"
Blueberries *Vaccinium spp.*	"	berry	W 0.14	"
" "	"	"	D 1.02	"
" "	"	"	A 14.6	"
Mountain cranberry *Vaccinium sp.*	Finland		A (<10.0-30.0) 6.0±SE 3.0	Lounamaa (1956)
Corn *Zea mays*	Illinois ?	grain	W 0.11	Schroeder et al. (1964)
" "	Vermont	"	W 0.12	"
"Fern"	"	frond	W 0.69	"
"	"	"	D 4.60	"
"	"	"	A 27.6	"
"	Finland	"	A (<10.0-10.0) 3.2±SE 0.21	Lounamaa (1956)
Conifers	"		A (<10.0-10.0) 3.2±SE 0.15	"
Honey	New York		W (0.002-7.5)	Tong et al. (1975)

TIN IN LOWER PLANTS(1)

Species	Locality	Tissue	Analysis(2) PPM	Authority
LICHENS				
Leconora rubina	Colorado		A 10.0	Leroy & Koksoy (1962)
Parmelia conspersa	" cretaceous sandstone		A 10.0	"
" "	" jurassic sandstone		A 10.0	"
Stereocaulon sp.			Sn highly concentrated	in Ferry et al. (1973)
Umbilicaria sp.			"	"
Umbilicaria hyperborea	Colorado		A (30.0-50.0) 35.0	Leroy & Koksoy (1962)
Xanthoria (*Caloplaca*) *elegans*	"		A 20.0	"
"Lichens"			up to 100.0	Ferry et al. (1973)

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FUNGI					
"Mushrooms"	United States		W	(0.72-1.08)	Schroeder et al. (1964)
ALGAE					
Brown alga, knotted wrack *Ascophyllum nodosum*	Scotland		D	(0.7-1.1)0.9	Black & Mitchell (1952)
" "	"		W	0.27	"
Brown alga *Fucus serratus*	"		D	(0.5-1.3)1.0	"
" "	"		W	0.1	"
Brown alga *Fucus spiralis*	"		D	(0.0-1.8)	"
" "	"		W	0.0	"
Brown alga, bladder wrack *Fucus vesiculosus*	"		D	(0.5-1.1)0.7	"
" "	"		W	0.25	"
Brown alga *Laminaria cloustoni*	"	frond	D	(1.0-1.4)	"
" "	"	sterile frond	D	0.7	"
" "	"	sporing frond	D	1.0	"
Brown alga *Laminaria digitata*	"	frond unwashed	D	3.8	"
" "	"	frond washed	D	1.0	"
" "	"	frond	D	(0.6-1.0)0.8	"
" "	"	stipe	D	(0.0-2.8)1.2	"

Brown alga *Laminaria digitata*	Scotland	frond	W (0.03-0.08)	Black & Mitchell (1952)
" "	"	stipe	W (0.24-0.36)	"
Red alga *Lithothamnium sp.*			detected in ash	in Vinogradov (1953)
Brown alga *Macrocystis pyrifera*			D 1.4	(1942) in Vinogradov (1953)
Brown alga *Pelvetia canaliculeta*	Scotland		D (0.8-2.2)1.4	Black & Mitchell (1952)
" "	"		W 0.51	"
Ulva pertusa	Japan		trace	Matida & Kumada (1969)
Microalgae, green	Germany		D (1.0-6.0) 2.5	Payer et al. (1975)
" "	Bangkok		D (0.7-3.5)1.5	"

VANADIUM IN MAMMALS(1)

Species	Locality	Tissue	Analysis(2) PPM		Authority
Cow *Bos bovis*	Sweden	calf liver	A	0.51	Söremark (1967)
" "	"	"	W	(0.0083-0.0118) 0.01	"
" "	Boston	"	A	0.11	"
" "	"	"	W	(0.0018-0.003) 0.0024	"
" "	Sweden	calf muscle	A	<0.0001	"
" "	"	calf teeth	A	<0.0001	"
" "	"	calf bone	A	<0.0001	"
" "	Germany	calf teeth	A	(29.0-41.5)	Dürr (1969)
" "	United States	muscle	W	0.0	Schroeder et al. (1963)
" "	"	kidney	W	0.0	"
" "	"	milk	W	0.01	"
" "	"	dry skim milk	D	6.52	"
" "	"	bone marrow	W	3.17	"

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Dog *Canis familiaris*	Germany	teeth	A	(29.0-41.5)	Dürr (1969)
Beaver *Castor virginianus*	United States	kidney	W	0.0	Schroeder et al. (1963)
" "	"	heart	W	0.0	"
Guinea pig *Cavia porcellus*	" (fed on swiss chard grown on sludge-amended soil)	liver	D	(1.2-2.0)1.6	Furr et al. (1976)
" "	"	kidney	D	(0.3-4.9)1.9	"
" "	"	muscle	D	(0.2-0.7)0.5	"
" "	"	adrenal	D	(0.4-0.9)0.6	"
" "	"	spleen	D	(0.4-1.4)0.8	"
Horse *Equus caballus*	Germany	teeth	A	(29.0-41.5)	Dürr (1969)
Gray seal *Halichoerus gryphus*	Farne Islands	male, liver	W	0.04	Hamilton (1976)
" "	"	female, liver	W	0.007	"
" "	"	pup, liver	W	0.005	"
Woodchuck *Marmota monax*	United States		W	(0.25-1.16)	Schroeder (1970)
" "	"	kidney	W	1.08	Schroeder et al. (1963)
" "	"	liver	W	0.0	"
" "	"	lung	W	0.0	"
" "	"	heart	W	1.11	"
" "	"	spleen	W	1.16	"

Mouse *Mus musculus*	United States (diet with 3.2 ppm V)	liver	W	0.0	Schroeder et al. (1963)
" "	" "	mammary tumor	W	(1.54-1.91)	"
" "	" "	fat	W	3.06	"
White-tail deer *Odocoilus virginiana*	"	hoof	W	2.55	"
" "	"	kidney	W	2.07	"
" "	"	liver	W	0.07	"
" "	"	heart	W	0.13	"
" "	"	aorta	W	0.0	"
" "	"	fat	W	6.82	"
Muskrat *Ondatra zibethica*	"		W	(0.25-1.16)	Schroeder (1970)
Domestic rabbit *Oryctolagus cuniculus*	" (on diet high V)	kidney	W	0.59	Schroeder et al. (1963)
" "	" "	liver	W	0.94	"
" "	" "	lung	W	0.0	"
" "	" "	heart	W	3.40	"
Rabbit *Oryctolagus virginiensis*	"		W	(0.25-1.16)	Schroeder (1970)
Sheep *Ovis aries*	"	lamb, muscle	W	0.0	Schroeder et al. (1963)
" "	"	" liver	W	0.0	"

Harbor seal *Phoca vitulina*	Scotland	blood	W	0.02±0.01	Hamilton (1976)
" "	"	spleen	W	0.008±0.002	"
" "	"	heart	W	0.02±0.01	"
" "	"	muscle	W	0.02±0.05	"
" "	"	kidney	W	0.05±0.02	"
" "	"	liver	W	0.2±0.001	"
" "	West Scotland	", male	W	0.3	"
" "	"	",female	W	0.2	"
" "	"	", pup	W	0.2	"
Rat *Rattus rattus*		V^{48} accumulated in hair			Strain et al. (1964)
" "	United States (on high V in diet)	kidney	W	0.0	Schroeder et al. (1963)
" "	" "	liver	W	0.39	"
" "	" "	lung	W	0.0	"
" "	" "	young	W	0.0	"
" "	" "	fat	W	0.06	"
" "	New York	liver	W	0.020	Welch & Allaway (1972)
" "	"	kidney	W	0.002	"
" "	"	muscle	W	0.019	"
" "	"	bone	W	0.009	"
Pig *Sus scrofa*	Stockholm	muscle	A	<0.0001	Söremark (1967)
" "	Germany	incisor & canine teeth	A	(29.0-41.5)	Dürr (1969)

Pig Sus scrofa	United States	muscle	W	0.0	Schroeder et al. (1963)
" "	"	liver	W	0.0	"
" "	"	kidney	W	0.0	"
" "	"	fat	W	6.76	"
Red fox Vulpes fulva	"		W	(0.25-1.16)	Schroeder (1970)
"Siberian deer"			D	0.2	Bertrand (1943)
"whale"		sperm oil	W	12.67	Schroeder et al. (1963)

VANADIUM IN BIRDS(1)

Species	Locality	Tissue	Analysis(2) PPM	Authority
Mallard *Anas platyrhynchos*	Canada	feather	D <0.02	Kelsall (1970)
Black duck *Anas rubripes*	"	"	D <0.02	"
White-fronted goose *Anser albifrons*	"	"	D <0.02	"
Lesser scaup *Aythya affinis*	"	"	D <0.02	"
Chicken *Gallus domesticus*		V^{48} accumulated in bone and kidney, also liver, spleen and gonads.		Hathcock et al. (1964)
" "	United States	muscle	W 0.14	Schroeder et al. (1963)
" "	"	fat	W 13.85	"
" "	"	egg yolk	W 0.68	"
" "	"	white	W 0.37	"

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VANADIUM IN MARINE FISH (1)

Species	Locality	Tissue	Analysis (2) PPM	Authority
Yellowfin goby Acanthogobius flavimanus	Japan	muscle	ND	Matida & Kumada (1969)
Wrasse Ctenolabrus rupestris	Sweden		D 1.6	Noddack & Noddack (1940)
Peruvian anchovy Engraulis ringens	Pacific		A (0.005-0.021)	Goldberg (1962)
Skipjack tuna Euthynnus pelamis	"		A 0.007	"
Whiting Gadus merlangus	Atlantic		D 0.14	Bertrand (1942)
Cod Gadus morhua?	"	muscle	D 0.96	Schroeder et al. (1963)
Majina Griella punctata	Japan	"	trace	Matida & Kumada (1969)

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Halibut *Hippoglossus hippoglossus*	Atlantic	muscle	W	0.0	Schroeder et al. (1963)
Konoshiro *Konosirus punctatus*	Japan	"		trace	Matida & Kumada (1969)
Dover sole *Microstomus pacificus*	S. California	muscle	W	(0.1-1.1)	Fowler et al. (1975)
Yellowfin tuna *Neothunnus macropterus*	Pacific		A	(0.005-0.055)	Goldberg (1962)
Calico bass *Paralabrax clathratus*	Catalina Island & Los Angeles	dorsal muscle	D	(1.9-3.3)	Stapleton (1968)
" "	"	ventral muscle	D	(1.7-3.2)	"
" "	"	gonad	D	(3.4-5.7)	"
" "	"	liver	D	(2.8-3.3)	"
" "	"	integument	D	2.9	"
" "	"	heart	D	3.2	"
" "	"	eyeball	D	(7.6-9.0)	"
Sardine *Sardinia pilchardus*	Sweden		A	0.28	Söremark (1967)
" "	"		W	(0.004-0.0132) 0.0086	"
" "	Norway		A	0.2	"
" "	"		W	(0.0042-0.01) 0.007	"
" "	Portugal		A	0.46	"
" "	"		W	(0.0081-0.018) 0.013	"

Mackerel *Scomber scombrus*	North Sea	soft tissues	A	0.20	Söremark (1967)
" "	"	"	W	(0.0015-0.0036) 0.0026	"
" "	"	bone	A	2.9	"
" "	"	"	W	(1.1-4.1)2.0	"
Scyllium canaliculata	Atlantic		D	0.04	Bertrand (1943)
Kurodai *Sparus macrocephalus*	Japan			ND	Matida & Kumada (1969)
Spiny dogfish *Squalus acanthius*	Sweden		D	1.8	Noddack & Noddack (1940)
Albacore *Thunnus alalunga*	Pacific		A	(0.005-0.02)	Goldberg (1962)
" "	"	heart	A	0.013	"
" "	"	spleen	A	0.016	"
" "	"	gall bladder	A	0.012	"
" "	"	liver	A	0.018	"
" "	"	pyloric caeca	A	0.019	"
" "	"	stomach	A	0.006	"
Albacore *Thunnus alalunga*	Pacific	gill	A	0.005	Goldberg (1962)
" "	"	eyeball	A	0.008	"
" "	"	integument	A	0.022	"
" "	"	bone	A	(0.005-0.008)	"
" "	"	dorsal flesh	A	0.015	"

Albacore *Thunnus alalunga*	Pacific	midline flesh	A	0.022	Goldberg (1962)
Trigla sp.	Atlantic		D	0.1	Bertrand (1943)
"fish"	Baltic Sea	bone	A	(0.05-0.5)	Söremark (1967)
"	North Sea	"	A	(2.8-7.1)	"
"	Lake Maelar	"	A	(0.005-0.05)	"

VANADIUM IN FRESHWATER FISH (1)

Species	Locality	Tissue	Analysis (2) PPM	Authority
Sturgeon *Acipenser sp.*	New York	decapitated & eviscerated	W 0.17	Tong et al. (1972)
White sucker *Catastomus commersoni*	"	"	W 2.9	"
Carp *Cyprinus carpio*	"	"	W 0.09	"
Northern pike *Esox lucius*	"	"	W (0.07-2.4)	"
Muskellunge *Esox masquinongy*	"	"	W (0.07-0.65)	"
Chain pickerel *Esox niger*	"	"	W (0.13-0.32)	"
Smallmouth bass *Micropterus dolomieui*	"	"	W (0.08-0.80)	"
Largemouth bass *Micropterus salmoides*	"	"	W (0.13-0.95)	"
Striped bass *Morone saxatilis*	"	"	W 0.09	"
Yellow perch *Perca flavescens*	"	"	W 0.24	"

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Black crappie *Pomoxis nigromaculatus*	New York	decapitated & eviscerated	W	0.10	Tong et al. (1972)
Lake trout *Salvelinus namaycush*	New York	muscle	W	(1.1-3.4)	" (1974)
" "	"	decapitated & eviscerated	W	(0.05-0.41)	" (1972)
Walleye *Stizostedion vitreum*	"	"	W	(0.05-2.4)	"
"Trout"			W	(0.0003-0.0007) 0.0004	Söremark (1967)

VANADIUM IN MOLLUSCA(1)

Species	Locality	Tissue	Analysis(2) PPM	Authority
Pteropod *Clione limacina*	New England	whole	A 16.0	Nicholls et al. (1959)
Oyster *Crassostrea sp.*	Atlantic		D 1.3	Bertrand (1943)
Atlantic oyster *Crassostrea virginica*	Texas	shell	D <1.0	Smith & Wright (1962)
Snail *Helix aspersa*			A 2.0	Vinogradov (1953)
Snail *Helix sp.*	Atlantic		D 0.5	Bertrand (1943)
Clam *Hormonia mutabilis*			trace	Matida & Kumada (1969)
Pteropod *Limacina retroversa*	New England	whole	A 85.0	Nicholls et al. (1959)
Periwinkle *Littorina littorea*			A 0.3	Vinogradov (1953)
Squid *Loligo sp.*	Atlantic		D 0.4	Bertrand (1943)

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"Mollusca"			D	0.7	Bowen (1966)
"		soft parts	D	1.0	Fukai & Meinke (1962)
Mussel *Mytilus edulis*	New Zealand	"	D	(2.0-8.0) 5.0	Brooks & Rumsby (1965)
" "	"	mantle	D	3.0	"
" "	"	gill	D	5.0	"
" "	"	muscle	D	2.0	"
" "	"	viscera	D	23.0	"
" "	"	intestine	D	25.0	"
" "	"	foot	D	44.0	"
" "	"	gonad	D	<2.0	"
" "	"	shell	D	110.0	"
" "	Atlantic		D	1.2	Bertrand (1943)
" "	Japan			trace	Matida & Kumada (1969)
Octopus *Octopus vulgaris*	"			"	"
Squid *Ommastrephes illicebrosa*	New England		A	4.0	Nicholls et al. (1959)
Oyster *Ostrea edulis*			W	0.2	Vinogradov (1953)
Oyster *Ostrea sinuata*	New Zealand	soft parts	D	(2.0-4.0) 3.0	Brooks & Rumsby (1965)
" "	"	mantle	D	12.0	"
" "	"	gill	D	3.0	"

Oyster *Ostrea sinuata*	New Zealand	muscle	D	<2.0	Brooks & Rumsby (1965)
" "	"	striated muscle	D	4.0	"
" "	"	viscera	D	<2.0	"
" "	"	kidney	D	4.0	"
" "	"	heart	D	4.0	"
" "	"	shell	D	49.0	"
European limpet *Patella vulgata*	Atlantic		D	0.1	Bertrand (1943)
Scallop *Pecten maximus*			A	0.2	Vinogradov (1953)
Scallop *Pecten novae-zelandica*	New Zealand	soft parts	D	(5.0-14.0) 9.0	Brooks & Rumsby (1965)
" "	"	mantle	D	7.0	"
" "	"	gill	D	3.0	"
" "	"	muscle	D	<2.0	"
" "	"	viscera	D	30.0	"
" "	"	intestine	D	16.0	"
" "	"	kidney	D	4.0	"
" "	"	foot	D	4.0	"
" "	"	gonad	D	32.0	"
" "	"	shell	D	130.0	"

Sea scallop *Placopecten magellanicus*	Delaware (ocean dump sites)	whole	D	(11.4-45.7) 28.5	Pesch et al. (1977)
Pleurobranchus plumula				150.0	Webb (1937)
Little-neck clam *Tapes japonica*	Japan	soft parts	A	15.0	Fukai & Meinke (1962)
" "	"	"	D	1.1	"

VANADIUM IN ARTHROPODS (1)

Species	Locality	Tissue	Analysis (2) PPM		Authority
CRUSTACEA					
Copepod *Calanus finmarchius*	New England	whole	A	21.0	Nicholls et al. (1959)
" "	"		D	3.7	"
Green crab *Carcinus moenas*	Atlantic		D	0.4	Bertrand (1943)
Copepod *Centropagus hamatus*	New England	whole	A	16.0	Nicholls et al. (1959)
Copepod *Centropagus typicus*	"	"	A	16.0	"
Charabdis japonica	Japan			trace	Matida & Kumada (1969)
Euphausid *Euphausia krohnii*	New England	"	A	45.0	Nicholls et al. (1959)
Lobster *Homarus vulgaris*	North Sea	muscle	A	16.1	Söremark (1967)

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Lobster *Homarus vulgaris*	North Sea	muscle	A	16.1	Söremark (1967)
" "	"	"	W	(0.032-0.053) 0.043	"
Leander adspersus				present	Petkevich & Stepanyuk (1970)
Lepas anatifera	Atlantic		D	1.2	Bertrand (1943)
Prawn *Pandalus sp.*	Japan	soft parts	A	1.1	Fukai & Meinke (1962)
" "	"	"	D	0.068	"
Crab *Cancer anthonyi*	S. California	muscle	W	0.2	Fowler et al. (1975)
INSECTA					
"Insects"			D	0.15	Bertrand (1950)

VANADIUM IN TUNICATES (1)

Species	Locality	Tissue	Analysis (2) PPM	Authority
Protochordata				
1. Ascidiidae				
Ascidia atra			present	(1918) in Vinogradov (1953)
Ascidia aspersa	Gulf of Kola		50.0	"
" "	"		A 1,030	(1932) in Vinogradov (1953)
" "	French Coast		A 2,775	"
" "	Great Britain		A 10,000	Webb (1937)
Ascidia aspersa scabra	"		D 1,120	"
Ascidia ceratodes			V^{48} concentrated in gut wall, ovary, & blood vessels	Goldberg et al. (1951)
Ascidia fumigata	Gulf of Naples		A 16,000 (in 1% of insoluble ash residue)	(1932) in Vinogradov (1953)

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Ascidia mentula	Gulf of Naples		A	9,820	(1913) in Vinogradov (1953)
" "	Great Britain		D	1,860	Webb (1939)
" "	Atlantic		D	982.0	Bertrand (1943)
" "	"		66% of V is in tunic		"
Ascidia mentula var. *rudis*			D	1,450	Webb (1939)
Ascidia nigra		centrifuged blood cells	D	14,500	Ciereszko et al. (1963)
Ascidia obliqua	Gulf of Kola		W	300.0	(1930) in Vinogradov (1953)
" "	"		A	4,638	(1918) "
" "	"	testa	A	400.0	" "
" "	"	inner organs	A	480.0	" "
" "	"	mantle	A	20.0	" "
Ascidia pruna	"		W	140.0	(1938) "
" "	"		A	2,750	" "
Ascidia pygmaea	Indian Ocean	Vacuolated amoebocytes collect and reduce V			Kalk (1963a)
Phallusia mammillata (=Ascidia mammillata)	Gulf of Naples		A	185,000	Henze (1911)
" "	Great Britain	blood pigment	D	1,700	Webb (1937)
" "	"	"	D	55,000	Webb (1939)
" "		egg	A	1,900	Ciereszko et al. (1963)
" "		"	D	170.0	"

2. Cionidae

Ciona	*intestinalis*	Bay of Naples		A	5,400	(1913) in Vinogradov (1953)
"	"	Gulf of Kola		W	13.0	(1932) "
"	"	"		A	400.0	"
"	"	Sweden		D	620.0	Noddack & Noddack (1940)
"	"	California	ovary	D	(0.0-2.5)	Goldberg et al. (1951)
"	"	"	anterior gut	D	(19.7-21.9)	"
"	"	"	posterior gut	D	(8.9-37.8)	"
"	"	"	stomach	D	(19.2-18.8)	"
"	"	Great Britain		D	400.0	Webb (1939)
"	"	Atlantic		D	166.0	Bertrand (1943)
"	"	Roscoff		A	15,000	in Vinogradov (1953)
"	"	Barents Sea Gulf of Kola		A	500.0	"
"	"	California		D	100.0	Goldberg et al. (1951)
"	"	"		Uptake studies with V^{48} showed Ciona can obtain all V from seawater.		"

3. Rhodosomatidae

Chelyosoma	*macleayanum*	Arctic			present	(1932) in Vinogradov (1953)

4. Diazonidae				
Diazona violaceae	Boreal	present		(1932) in Vinogradov (1953)
Stolidobranchiata				
5. Botryllidae				
Botrylloides schlosseri	Barents Sea, Gulf of Kola	W	92.0	(1934) in Vinogradov (1953)
" "	"	A	1,193	"
" "	Atlantic, France	A	931.0	(1932) "
" "	"	A	365.0	"
" "	"	D	8.0	Bertrand (1943)
" "	"	A	<20.0	in Vinogradov (1953)
6. Pyuridae				
Microcosmus glacialis	Gulf of Kola	A	0.0	(1934) in Vinogradov (1953)
Microcosmus sulcatus		A	<20.0	"
Pyura pyriformis	"	A	0.0	"
Pyura stolonifera	Australia	A	0.0	(1953) in Hudson (1964)
Pyura savigni	Atlantic	D	7.0	Bertrand (1943)
7. Styelidae				
Dendrodoa grossularia	"	D	10.0	"
" "	Great Britain	D	48.0	Webb (1939)

	Distomus varialosus Atlantic		D	6.0	Bertrand (1943)
	Styelia bonharti	California	D	0.0	Goldberg et al. (1951)
	Styela montereyensis	"	D	0.0	"
	Styela rustica	Barents Sea	A	0.0	(1934) in Vinogradov (1953)
	Styelopsis grossularia French Coast		A	331.0	(1932) "
	" "	Barents Sea	W	68.0	"
	" "	"	A	1,300	"
8.	Molgulidae				
	Eugyra adriatica	Black Sea	floating form A	0.0	"
	Molgula manhattensis Atlantic		D	32.0	Bertrand (1943)
Aplousobranchiata					
9.	Didemnidae				
	Didemnum albidum	Gulf of Kola	A	0.0	(1934) in Vinogradov (1953)
	Didemnum candidum	Atlantic	D	2.6	Bertrand (1943)
	Didemnum maculosum	"	D	30.0	"
10.	Synoicidae				
	Amaroucium mutabile Gulf of Kola		A	0.0	(1934) in Vinogradov (1953)
	Aplidium pallidum	Atlantic	D	4.3	Bertrand (1943)
	Morchellium argus	French Coast	A	0.0	"
	" "	Atlantic	D	3.7	"

Parascidia aureolata	Atlantic	D	3.9	Bertrand (1943)
Parascidia elegans	Gulf of Kola	A	0.0	(1932) in Vinogradov (1953)
Parascidia turbinata	Atlantic	D	8.3	Bertrand (1943)
Sidnyum turbinatum	French Coast	A	0.0	(1932) in Vinogradov (1953)
11. Palycitoridae				
Clavelina lepadiformis	Atlantic	D	7.0	Bertrand (1943)
Distoma crystallinum	Gulf of Kola	W	20.0	(1938) in Vinogradov (1953)
" "	"	A	240.0	"
Euherdmania claviformis	California	D	475.0	Goldberg et al. (1951)
Tethyum partitum		A	<20.0	in Vinogradov (1953)
Salpa fusiformis	New England	A	7.0	Nicholls et al. (1959)
Salpa sp.			0.2	"

VANADIUM IN LOWER ANIMALS(1)

Species	Locality	Tissue	Analysis(2) PPM	Authority
ECHINODERMATA				
Holothuroidea				
Sea cucumber *Cucumaria frondosa*	Bering Sea		0.0	(1900) in Vinogradov (1953)
Sea cucumber *Cucumaria lefevrei*	Atlantic		D 1.0	Bertrand (1943)
Sea cucumber *Molpadia affinis*	Bering Sea		0.0	(1900) in Vinogradov (1953)
Sea cucumber *Stichopus japonicus*		viscera, body fluid	D 12.0	Ciereszco et al. (1962)
Sea cucumber *Stichopus japonicus* var. *armatus*	Bering Sea		0.0	(1900) in Vinogradov (1953)
Brown spotted sea cucumber *Stichopus mobii*	Tortugas		A 1,230	Phillips (1918)

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Sea cucumber *Stichopus tremulans*	Sweden		D	57.0	Noddack & Noddack (1940)
Asteroidea					
Sea star *Asterias glacialis*	Atlantic		D	3.0	Bertrand (1943)
Sea star *Asterias rubens*	Sweden		D	9.0	Noddack & Noddack (1940)
Echinoidea					
Sea urchin *Brissopsis lyrifera*	"		D	5.0	"
Sea urchin *Paracentrotus lividus*	Atlantic		D	0.8	Bertrand (1943)
PORIFERA					
Sponge *Choanites ficus*			D	1.7	Vinogradov (1953)
Sponge *Halichondra sp.*	Sweden		D	30.0	Noddack & Noddack (1940)
"Porifera"		hard tissue		1.7	Bowen (1966)
Sponge *Terpios zeteki*			accumulates V		Bowen & Sutton (1951)
COELENTERATA					
Sea anemone *Anemonia sulcata*	Atlantic		D	2.3	Bertrand (1943)
Jelly fish *Cyanea capillata*	Sweden		D	5.0	Noddack & Noddack (1940)

Jelly fish *Cyanea capillata*	New England	whole	A	5.0	Nicholls et al. (1959)
" "	"	"	D	3.1	"
"Coelenterates"		"	W	0.1	"
Sea anemone *Metridium dianthus*	Sweden		D	40.0	Noddack & Noddack (1940)
"Sea anemone"	Japan		trace		Matida & Kumada (1969)
CTENOPHORA					
Comb jelly *Beröe cucumis*	New England	whole	A	8.0	Nicholls et al. (1959)
"Ctenophores"	"	"	W	0.3	"
CHAETOGNATHA					
Arrow worm *Sagitta elegans*	"	"	A	13.0	"
" "	"	"	W	0.3	"
ANNELIDA			D	1.2	Bowen (1966)

VANADIUM IN HIGHER PLANTS(1)

Species	Locality	Tissue	Analysis PPM	Authority
Maple *Acer glabrum*	W. United States	root	D 8.9	Hopkins et al. (1977)
" "	"	leaf	D 2.0	"
Sugar maple *Acer saccharum*	New England		W 0.93	Schroeder et al. (1963)
" "	"	twig	D 150.0 (max.)	Smith (1973)
Bunch grass *Agropyron sp.*	Utah (near phosphate plant)	leaf & stem	A (15.0-300.0)	Gough & Severson (1976)
Onion *Allium cepa*	New England		W 0.06	Schroeder et al. (1963)
Wild onion *Allium macropetalum*	Utah	whole	D 133.0	Cannon (1964)
Garlic *Allium sativum*	"		W 0.0	Schroeder et al. (1963)
Ragweed *Ambrosia sp.*	New Jersey		V present	Prince (1959)

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Peanut *Arachis hypogaea*	Lower Dahomey		D	<0.5	Cresta et al. (1975)
" "	United States		W	0.0	Schroeder et al. (1963)
" "	"	oil	W	10.87	"
Sagebrush *Artemisia bigelovi*	Utah	top	A	50.0 V_2O_5	Cannon (1960)
" "	"	root	A	5.0 "	"
Sagebrush *Artemisia spinescens*	"	top	A	70.0 "	"
" "	"	root	A	100.0 "	"
Big sagebrush *Artemisia tridentata tridentata*	Utah (near phosphate plant)	leaf stem & flower	A	(30.0-700.0)	Gough & Severson (1976)
Asparagus *Asparagus officionalis*			V added at 0.001 ppm to growth solution caused increased growth.		Hudson (1964)
Woody aster *Aster venustrus*	Utah	top	D	21.0	Cannon (1964)
Locoweed *Astragalus confertiflorus*	"	"	A	900.0	" (1963)
" "	"	"	D	144.0	" (1964)
Locoweed *Astragalus pattersoni*	Colorado		A	30.0	" (1969)
Locoweed *Astragalus preussi*	"		A	400.0	"
" "	Utah	top	A	3,000.0 V_2O_5	" (1960)
" "	"	root	A	2,600.0 "	"
" "	"	top	D	67.0	" (1964)

Locoweed Astragalus spp.	United States Uranium ore districts	max. in top	A	1,680.0	Cannon (1969)
" "	" "	"	D	319.0	"
Saltbush Atriplex confertifolia	Utah	top	A	10.0 V_2O_5	" (1960)
" "	"	root	A	90.0 "	"
Saltbush Atriplex spp.	New Mexico (Four corners power plant)	(1962)		3.8	Cannon & Anderson (1972)
" "	" "	(1973)		3.0	"
Oats Avena sativa	New England	seed	W	(1.33-1.36)	Schroeder et al. (1963)
Barberry Berberis vulgaris	"		W	1.25	"
Beet Beta vulgaris	Sweden		A	0.0001	Soremark (1967)
" "	"		D	<0.00001	"
" "	New Hampshire		W	0.88	Schroeder et al. (1963)
" "	Russia, Kiev		W	(0.39-0.65)	Barannik et al. (1970)
Swiss chard Beta vulgaris cicla	United States	soil	D	6.7	Furr et al. (1976)
" " "	"	sludge on pH 6.5 soil	D	7.8	"
" " "	"	sludge on pH 5.5 soil	D	1.5	"
" " "	New England		W	1.04	Schroeder et al. (1963)

Carrot *Daucus carota*	Sweden		A	<0.0001	Soremark (1967)
" "	New Hampshire		A	0.0001	"
" "	"		W	0.99	Schroeder et al. (1963)
" "			W	0.254	Bertrand (1941)
" "	Russia, Kiev		W	(0.69-1.1)	Barannik et al. (1970)
" "	Sweden (uptake of V^{48} from soil; % of V^{48} of carrot)	root	A	6.55×10^{-4}%	Söremark (1967)
" "	" "	leaf	A	3.57×10^{-4}%	"
Desert trumpet *Eriogonum inflatum*	Utah	top	D	15.0	Cannon (1964)
Buckwheat *Fagopysum esculentum*	New England	seed	W	1.98	Schroeder et al. (1963)
Beech *Fagus grandifolia*	"		W	0.0	"
Meadow fescue *Festuca elatior*		head	D	0.06	Fleming (1963)
" "		leaf	D	0.22	"
" "		stem	D	0.05	"
Strawberry *Fragaria sp.*	Sweden (wild)		A	0.72	Söremark (1967)
" "	"		D	0.041	"
Strawberry *Fragaria vesca*	New Hampshire		A	0.66	"
" "	"		D	0.031	"

Ash Fraxinus americanus	New England		W	0.0		Schroeder et al. (1963)
Soybean Glycine max			V can partially correct ill effects of iron deficiency caused by Mn excess			Hudson (1964)
" "	United States	oil	W	43.53		Schroeder et al. (1963)
" "	"	edible oil	W	14.77		"
Composite Haplopappus armerioides	Utah	top	A	260.0	V_2O_5	Cannon (1960)
" "	"	root	A	180.0	"	"
Sunflower Helianthus sp.	New England	oil seed	W	6.95		Schroeder et al. (1963)
Black walnut Juglans nigra	"	outer shell	W	3.38		"
" "	"	nut	W	0.26		"
Juniper Juniperus communis	"		W	0.27		"
Juniper Juniperus monosperma	Utah (near mine workings)	deep root	A	(3000.0-4000.0)	V_2O_5	Cannon (1960)
" "	" "	top	A	(20.0-50.0)		"
" "	"	near surface root	A	110.0		"
" "	"	top	A	54.0		"
Juniper Juniperus sp.	"	root	A	110.0		" (1964)
" "	"	branch tip	A	55.0		"

Juniper Juniperus sp.	Utah	3 m deep peeled root	A	2,200.0	Cannon (1964)
" "	"	surface peeled root	A	78.0	"
Cedar Juniperus virginianus	Missouri	twig & needle	D	(<1.2-160.0)	Connor et al. (1970)
Lettuce Lactuca sativa	New Hampshire		W	1.08	Schroeder et al. (1963)
" "	Sweden		A	2.8	Söremark (1967)
" "	"		D	0.58	"
" "	"		W	(0.019-0.023) 0.021	"
" "	New England	head	W	1.08	Schroeder et al. (1963)
Lentil Lens culinaris	"		D	6.0	"
Pepperweed Lepidium montanum	Utah	top	D	11.0	Cannon (1964)
Perennial rye grass Lolium perenne		head	D	0.07	Fleming (1963)
" "		leaf	D	0.27	"
" "		stem	D	0.04	"
Tomato Lycopersicon esculentum	New Hampshire		W	0.0	Schroeder et al. (1963)
" "	"		A	0.041	Söremark (1967)
" "	"		D	0.00053	"
" "	"		W	0.000027	"
" "	New York	stem & leaf	D	0.463	Welch & Alloway (1972)

Cauliflower *Brassica oleracea botrytis*	Sweden		A	0.093	Söremark (1967)
" " "	"		D	0.00109	"
" " "	"		W	0.000077	"
Cabbage *Brassica oleracea capitata*	New England		W	1.75	Schroeder et al. (1963)
Turnip *Brassica rapa*	"	root	W	(0.0-1.47)	"
" "	"	stem & leaf	W	0.02	"
Caraway, parsley *Carum sp.*	Sweden	top	D	4.5	Söremark (1967)
Hickory *Carya sp.*	"	nut	W	1.96	"
Paintbrush *Castilleja angustifolium*	Utah	top	D	37.0	Cannon (1964)
Rabbitbrush *Chrysothamnus viscidiflorus*	"	branch tip	D	37.0	"
Tangerine *Citrus reticulata*	Florida		W	0.18	Schroeder et al. (1963)
Cucumber *Cucumis sativus*	Sweden		A	0.38	Söremark (1967)
" "	"		D	0.056	"
" "	"		W	0.002	"
Squash (Hubbard) *Cucurbita sp.*	New England		W	1.23	Schroeder et al. (1963)
Orchard grass, cocksfoot *Dactylus glomerata*		head	D	0.11	Fleming (1963)
" "		leaf	D	0.23	"
" "		stem	D	0.05	"

Tomato *Lycopersicon esculentum*	Lower Dahomey		D	2.2	Cresta et al. (1975)
Apple *Malus malus*	New Hampshire	leaf	W	0.0	Schroeder et al. (1963)
" "	"	fruit	W	0.78	"
" "	"		A	0.33	Söremark (1967)
" "	"		D	0.0086	"
" "	"		W	0.0011	"
" "	Russia, Kiev		W	(0.21-0.33)	Barannik et al. (1970)
Cassava *Manihot utilitissima*	Lower Dahomey	root	D	(<0.5-4.3)	Cresta et al. (1975)
" "	"	leaf	D	2.5	"
Alfalfa *Medicago sativa*				to 4.0	Nat. Acad. Sci. (1974a)
" "	New York	stem & leaf	D	0.115	Welch & Allaway (1972)
" "	New England		W	4.00	Schroeder et al. (1963)
Banana *Musa sapientum*	"		W	0.06	"
Primrose *Oenothera caespitosa*	New Mexico	top	D	38.0	Hopkins et al. (1977)
Sensitive fern *Onoclea sensibilis*	New England		W	0.25	Schroeder et al. (1963)
Rice *Oryza sativa*	Lower Dahomey	grain	D	(<0.5-0.3)	Cresta et al. (1975)

Rice *Oryza sativa*	United States	polished seed	W	0.23	Schroeder et al. (1963)
" "	Japan	"	W	0.82	"
Indian rice grass *Oryzopsis hymenoides*	Utah	root	A	1,600.0 V_2O_5	Cannon (1960)
" "	"	top	A	70.0 "	"
" "	Colorado (over U ore)		A	690.0	"
" "	" "		D	55.0	"
Avocado *Persea americana*	United States		W	0.09	Schroeder et al. (1963)
Garden parsley *Petroselinum crispum*	New Hampshire		A	29.5	Söremark (1967)
" "	"		D	4.52	"
" "	"		W	(0.5-1.11) 0.79	"
" "	Sweden		A	>29.5	"
" "	"	uptake of V^{48} as % of V^{48} in soil/g parsley	A	0.00566%	"
" "	"	"	D	0.0015%	"
" "	"	"	W	0.000145%	"
Bean *Phaseolus sp.*	Lower Dahomey	bean	D	<0.5	Cresta et al. (1975)
" "	"	leaf	D	2.5	"
" "	New York	stem & leaf	D	0.298	Welch & Allaway (1972)

Bean *Phaseolus sp.*	New England	plant	W	0.55	Schroeder et al. (1963)
" "	"	bean	D	5.04	"
" "	"	lima bean	W	0.0	"
" "	"	string bean	W	0.87	"
Timothy *Phleum pratense*	New York	leaf & stem	D	0.083	Welch & Allaway (1972)
" "		head	D	0.09	Fleming (1963)
" "		leaf	D	0.16	"
" "		stem	D	0.02	"
Red spruce *Picea rubra*	New England		W	0.0	Schroeder et al. (1963)
Ponderosa pine *Pinus ponderosa*	W. United States	needle	D	(ND-0.41)	Hopkins et al. (1977)
" "	"	twig	D	(0.46-0.96)	"
" "	"	cone	D	5.0	"
" "	"	wood	D	0.65	"
" "	"	root	D	(1.2-5.2)	"
Pine *Pinus sp.*		Used for geochemical prospecting for V			NASA (1968)
White pine *Pinus strobus*	New England		W	0.0	Schroeder et al. (1963)
Peas *Pisum sativum*	New Hampshire		A	0.0001	Söremark (1967)
" "	"		D	<0.00001	"
" "	"		W	0.46	Schroeder et al. (1963)

Pea Pisum sativum	New Hampshire	green plant	W	3.27	Schroeder et al. (1963)
" "	"	"	W	2.13	"
" "	"		W	0.186	Bertrand (1941)
" "	United States		D	0.03	Mitchell (1957)
Trembling aspen Populus tremuloides	W. United States	whole	D	0.0	Hopkins et al. (1977)
" "	New England		W	0.0	Schroeder et al. (1963)
Wild cherry Prunus serotina	"	leaf	W	0.76	"
" "	"	fruit	W	1.27	"
Douglas fir Pseudotsuga taxifolia	W. United States	needle	D	(ND-0.51)	Hopkins et al. (1977)
" "	"	twig	D	(0.42-0.55)	"
" "	"	cone	D	2.9	"
" "	"	wood	D	0.40	"
" "	"	root	D	(1.9-2.0)	"
Pear Pyrus communis	New Hampshire		A	0.0001	Söremark (1967)
" "	"		W	0.05	Schroeder et al. (1963)
" "	Russia, Kiev		W	(0.11-0.24)	Barannik et al. (1970)
White oak Quercus alba	New England		W	0.31	Schroeder et al. (1963)
Gambel's Oak Quercus gambeli	Utah	top	A	90.0	Cannon (1960)
" "	"	root	A	1,700.0	"

Radish *Raphanus sativus*	New Hampshire		A	7.9	Soremark (1967)
" "	"		D	1.26	"
" "	"		W	0.0521	"
" "	"	root	W	3.02	Schroeder et al. (1963)
" "	"	leaf	W	2.53	"
" "	Russia, Kiev		W	(0.4-0.54)	Barannik et al. (1970)
Staghorn sumach *Rhus typhina*	New England	berry	W	0.0	Schroeder et al. (1963)
Rye *Secale cereale*	"	seed	W	1.24	"
Potato *Solanum tuberosum*	New Hampshire	tuber	A	0.0093	Soremark (1967)
" "	"	"	D	0.0064	"
" "	"	"	W	0.00082	"
" "	"	"	W	1.49	Schroeder et al. (1963)
" "	Russia, Kiev		W	(0.02-0.07)	Barannik et al. (1970)
Spinach *Spinacia oleracea*	Sweden uptake of V^{48} as % of V^{48} in soil/g spinach		A	0.0000595%	Söremark (1967)
" "	Lower Dahomey		D	(2.5-5.3)3.7	Cresta et al. (1975)
Basswood *Tilia americana*	New England		W	0.0	Schroeder et al. (1963)

Spanish moss *Tillandsia usnoides*	United States	whole	A	(15.0-500.0) geom. mean 91.0 ± geom. dev. 1.73	Shacklette & Connor (1973)
White clover *Trifolium repens*	New England		W	0.70	Schroeder et al. (1963)
" "		petiole & leaf	D	0.27	Fleming (1963)
" "		stem	D	0.08	"
Clover *Trifolium sp.*		Used for geochemical prospecting for V			NASA (1968)
Wheat *Triticum aestivum*	United States	top	D	5.0	Monier & Williams (1950)
" "	"	grain	D	(<0.0065-0.0162)	Welch & Carey (1975)
Hemlock *Tsuga canadensis*	New England		W	0.0	Schroeder et al. (1963)
" "	"	twig	D	150.0 (max.)	Smith (1973)
Tulip *Tulipa sp.*	"	bulb	W	(0.0-0.85)	Schroeder et al. (1963)
Elm *Ulmus americana*	"		W	0.0	"
Red whortleberry *Vaccinium sp.*	Sweden		A	0.54	Söremark (1967)
" "	"		D	0.01	"
" "	"		W	0.0011	"
Grape *Vitis sp.*	New England		W	0.97	Schroeder et al. (1963)

Corn *Zea mays*	New Jersey		D	(0.37-1.05) 0.60	Prince (1957)
" "	Lower Dahomey		D	<0.5	Cresta et al. (1975)
" "	New York	leaf	D	0.244	Welch & Allaway (1972)
" "	New Jersey			(0.36-1.1)	Prince (1957)
" "	New England	grain	W	0.57	Schroeder et al. (1963)
" "	"	oil	W	(11.05-15.80)	"
Akassa	Lower Dahomey		D	(<0.5-0.3)	Cresta et al. (1975)
Igname	"		D	<0.5	"
Gombo	"		D	<0.5	"
Palm	"	nut	D	<2.0	"
Dill	Sweden		A	4.6	Söremark (1967)
"	"		D	0.84	"
"	"		W	0.14	"
Grass			A	25.0	Cannon (1960)
Other herbs			A	23.5	"
Shrubs		leaf	A	25.0	"
Deciduous trees			A	16.0	"
Conifers		needle	A	21.0	"
Herbaceous plants	Toxic amts. of V cause growth acceleration and early fruiting, stunted growth.				"
62 specimens of fruits, vegetables, and plants	(Root had more V than leaf)		D	1.0 (ave.)	Bertrand (1941)
" "	(Root nodules of most legumes)		D	(4.0-12.0)	"

VANADIUM IN MOSS, LICHENS AND FUNGI (1)

Species	Locality	Tissue	Analysis (2) PPM	Authority
MOSSES				
Copper moss *Mielichhoferia macrocarpon*			A 1,000.0	Peterson (1971)
Copper moss *Mielichhoeferia sp.*	Alaska	whole	D 154.0	Shacklette (1967)
LICHENS				
Lecanora rubina	Colorado, lower Cretaceous rock		50.0	Leroy & Koksoy (1962)
Parmelia conspersa	" "		50.0	"
" "	" Jurassic rock		50.0	"
Umbilicaria hyperborea	", lower Cretaceous rock		70.0	"
" "	", Jurassic rock		(50.0-70.0)	"
Xanthoria (Caloplaca) elegans	" lower Cretaceous rock		70.0	"

(1) Blank spaces indicate information not available or not applicable. ? indicates questionable data.

(2) W, D or A indicates on a Wet, Dry or Ashed basis. A single number indicates a single determination or mean. (x-y) indicates range of values, followed by the mean. ±Standard deviation (SD), standard error (SE), median, and geometric mean are indicated as reported. pCi/g = picocuries per gram.

FUNGI

Aspergillus niger		V is required trace element.			Hudson (1964)
Amanita muscaria	France	cap	D	(61.0-181.0)	Bertrand (1943)
" "	"			112.0 (contains 100x as much V as other fungi or higher plants)	" (1950)
" "	"		A	2,000.0	Peterson (1971)
"Fungi"				(usually under 0.5	Bertrand (1950)
"Fungi"			D	0.67	Bowen (1966)

VANADIUM IN ALGAE (1)

Species	Locality	Tissue	Analysis (2) PPM	Authority
Brown alga *Agarum cribosum*	Sea of Japan		D 4.97	Saenko et al. (1976)
" "	"		D (11.0-20.6)	Gryzhankova et al. (1973)
Brown alga *Ascophyllum nodosum*	Scotland		D (1.5-2.8) 2.06	Black & Mitchell (1952)
" "	"		W 0.69	"
Red alga *Chondrus yendoi*	Sea of Japan		D 2.11	Saenko et al. (1976)
Brown alga *Chorda filum*	"		D 1.63	"
" "	"		D (1.07-1.29)	Gryzhankova et al. (1973)
Seaweed *Chordaria maggelanica*	"		D 19.4 ± SE 0.9	"

(1) Blank spaces indicate information not available or not applicable. ? indicates questionable data.

(2) W, D or A indicates on a Wet, Dry or Ashed basis. A single number indicates a single determination or mean. (x-y) indicates range of values, followed by the mean. ± Standard deviation (SD), standard error (SE), median, and geometric mean are indicated as reported. pCi/g = picocuries per gram.

Seaweed *Coccophora langsdorfi*	Sea of Japan	D	5.7±SE 0.2	Gryzhankova et al. (1973)
Green alga *Codium sp.*	"	D	(11.7-12.8)	"
Green alga *Codium yessoensis*	"	D	1.46	Saenko et al. (1976)
Brown alga *Costaria costata*	"	D	ND	"
Seaweed *Dictyota dichotoma*	"	D	8.6±SE 0.7	Gryzhankova et al. (1973)
Green alga *Enteromorpha prolifera*	"	D	ND	Saenko et al. (1976)
Green alga *Enteromorpha sp.*	"	D	(19.0-21.3)	Gryzhankova et al. (1973)
Brown alga *Fucus serratus*	Scotland	D	(0.6-3.3)2.0	Black & Mitchell (1952)
" "	"	W	0.12	"
Brown alga *Fucus spiralis*	"	D	(1.9-11.9)6.9	"
" "	"	W	2.2	"
Brown alga *Fucus vesiculosus*	"	D	(1.7-1.9)1.8	"
" "	"	W	0.39	"
Brown alga *Heterochordaria abietina*	Sea of Japan	D	0.66	Saenko et al. (1976)
Brown alga *Laminaria cichorioides*	"	D	0.33	"

Brown alga *Laminaria cloustoni*	Scotland	frond	D	(0.9-1.1)	Black & Mitchell (1952)
" "	"	sterile	D	1.3	"
" "	"	sporing	D	1.1	"
Brown alga *Laminaria digitata*	"	frond	D	(0.4-2.0)1.0	"
" "	"	stipe	D	(0.3-2.2)1.1	"
" "	"	frond	W	0.12	"
" "	"	stipe	W	(0.09-0.13)	"
" "	"		A	50.0	"
Brown alga *Laminaria japonica*			D	0.53	Saenko et al. (1976)
Brown alga *Pelvetia canaliculata*	"		D	(1.2-3.2)2.3)	Black & Mitchell (1952)
" "	"		W	0.74	"
Brown alga *Pelvetia wrightii*	Sea of Japan		D	0.62	Saenko et al. (1976)
" "	"		D	12.8±SE 0.8	Gryzhankova et al. (1973)
Red alga *Polysiphonia japonica*	"		D	7.45	Saenko et al. (1976)
Red alga *Porphyra sp.*	Japan		A	212.0	Fukai & Meinke (1962)
" "	"		D	16.0	"

Red alga *Ptilota filicina*	Sea of Japan		D	5.73	Saenko et al. (1976)
Red alga *Rhodomela larix*	"		D	1.27	"
Sargassum weed *Sargassum miyabei*	"		D	7.8±SE 0.8	Gryzhankova et al. (1973)
Sargassum weed *Sargassum pallidum*	"		D	0.59	Saenko et al. (1976)
" "	"	leaf blade	D	7.4±SE 0.3	Gryzhankova et al. (1973)
" "	"	swim bladder	D	2.42±SE 0.5	"
" "	"	stem	D	14.2±SE 0.6	"
Red alga *Trichocarpus crinitus*	"		D	4.2±SE 0.7	"
Green alga *Ulva fenestrata*	"		D	0.54	Saenko et al. (1976)
" "	"		D	3.7±SE 0.6	Gryzhankova et al. (1973)
Green alga *Ulva sp.*	Japan, Sagami Bay		A	5.9	Fukai & Meinke (1962)
" "	" "		D	1.3	"
" "	", Tokyo Bay		A	13.3	"
" "	" "		D	3.1	"
Green alga *Ulvaria splendens*	Sea of Japan		D	1.83	Saenko et al. (1976)

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